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REPORT

OF THE

PROCEEDINGS OF THE FOREST CONFERENCE

HELD AT

SIMLA, OCTOBER 1875.

EDITED BY

D. BRANDIS, F.R.S.,

AND

A. SMYTHIES, B A.

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NOTE.—The following papers, which were read at the Conference, either entirely or in part, have already appeared in print, or will eventually do so. It has not, therefore, been considered necessary to publish them in this report :—

1. *Mr. Brandis.*—"The Aim and Object of Forestry in India" will appear in the "INDIAN FORESTER."
2. *Mr. McKee.*—"On the Cultivation of Lac in the Central Provinces" appeared in the January 1876 number of the same journal.
3. *Dr. Warth.*—"On the Impregnation of Wood" appeared in the July 1876 number of the same journal.
4. *Lieut. deWolski.*—"On the Working of Wire Rope Tramways" will be published by the Author.
5. *Mr. Smythies.*—"On Forest Terminology" appeared in the January 1876 number of the "INDIAN FORESTER."

ERRATA.

Page 1. Add under "*VI, Government of the Punjab,*" "Mr. C. B. Leupolt, Executive Engineer, Simla."

Page 40, line 26 from bottom, for *guardsmen*, read *guards, men.*

Ibid, line 7 „ insert comma after *Conservator.*

Page 62, line 31 from top, for *coute qui coute*, read *coûte que coûte.*

Page 63, line 13 „ for *feet* read *inches.*

Page 64, line 31 } „ read *Arbor-tristis.*
Page 65, line 33 }

Ibid, line 34 „ read *Vahlii.*

Page 69, line 2 from bottom, for *nertiæ* read *inertiæ.*

Page 71, line 34 from top, for *inches* read *feet.*

Page 80, line 15 „ for *Forset* read *Forest.*

Page 81, line 18 „ for *Govornment* read *Government.*

Page 82, line 41 „ for *inclinations* read *bearings.*

Page 83, line 18 from bottom, for *Herrn* read *Herr.*

Ibid, line 19 „ read *Herr Oberforstrath.*

Page 84, line 4 „ read *Bestandeskarte.*

Page 86, paragraph 9, last line, for *Specialkarte* read *Bestandeskarte.*

Page 94, line 4 „ read *Lagerstræmia.*

Ibid, line 5 „ read *Semecarpus Anacardium.*

Page 115, line 17 „ read *dealbata.*

Page 123, line 10 from bottom, for *on* read *no.*

REPORT

OF

THE PROCEEDINGS OF THE FOREST CONFERENCE,

1875.

THE following officers were deputed to attend by the Government of India a other Governments and Administrations:—

I.—Government of India—

Mr. D. Brandis, F.R.S., Inspector-General of Forests.
Captain F. Bailey, R.E., Superintendent of Forest Surveys.
Mr. H. C. Hill, Assistant Conservator of Forests, Forest Surveys.

II.—Government of Madras—

Colonel Hessey, Deputy Superintendent, Revenue Surveys.
Captain J. Campbell Walker, Officiating Inspector of Forests.

III.—Government of Bombay—

Mr. W. H. Horsley, C.S., Demarcation Officer.
„ A. F. Shuttleworth, Conservator of Forests, Northern Division.
„ W. H. A. Wallinger, Deputy Conservator of Forests.
„ G. L. Gibson, Assistant Conservator of Forests.
„ R. C. Wroughton, „ „
„ W. Dunbar, „ „
„ R. B. Oliphant, „ „

IV.—Government of Bengal—

Dr. W. Schlich, Conservator of Forests.
Mr. W. Johnstone, Assistant Conservator of Forests.

V.—Government of the North-Western Provinces—

Mr. G. Greig, Officiating Conservator of Forests.
„ C. F. Amery, Deputy „ „
„ C. Bagshawe, Officiating Deputy Conservator of Forests.
„ A. R. Grant, Assistant Conservator of Forests.
„ A. Pengelly, „ „
Captain Campbell, „ „
Mr. E. P. Dunsey, „ „

VI.—Government of the Punjab—

Lieutenant-Colonel McMahon, Deputy Commissioner, Simla.
Mr. W. Coldstream, C.S., Assistant Commissioner, Simla.
Captain W. Stenhouse, Officiating Conservator of Forests.
Mr. G. Duff, Deputy Conservator of Forests.
„ R. Ellis, Assistant „ „
„ C. F. Elliott, „ „
„ F. d'A. Vincent, „ „

VII.—Chief Commissioner of Assam—

Mr. Gustav Mann, Deputy Conservator of Forests.

VIII.—Chief Commissioner of Oudh—

Captain E. S. Wood, Conservator of Forests.

IX.—Chief Commissioner of the Central Provinces—

Captain J. C. Doveton, Conservator of Forests.
Mr. R. Thompson, Deputy Conservator of Forests.
„ J. A. McKee, Assistant „ „
„ E. E. Fernandez, „ „ „
„ A. Smythies, „ „ „
„ E. Dobbs, Sub-Assistant „ „

X.—Chief Commissioner of Mysore and Coorg—

Captain G. J. Van Someren, Conservator of Forests.

XI.—Resident at Hyderabad—

Mr. G. F. Prevost, Assistant Conservator of Forests.

XII.—Chief Commissioner of Ajmere—

Major Repton, Deputy Commissioner.
Mr. E. M'A. Moir, Assistant Conservator of Forests.

XIII.—Bhâwalpur State—

Mr. H. Calthrop, Forest Officer.

The meetings were also attended by—

Honourable Sir Alexander J. Arbuthnot, K.C.S.I.
Colonel Thuillier, C.S.I., Surveyor-General of India.
Mr. Guilford Molesworth, Consulting Engineer to the Government of India for State Railways.
Major Goad, Simla.
Major Waterfield, Deputy Commissioner, Hazára.
Surgeon-Major Henderson, Lahore.
Lieutenant R. de Wolski, Royal Engineers.
Mr. E. Kellner, Assistant Comptroller General of Accounts, Calcutta.
„ J. E. O'Connor, Assistant Secretary to the Government of India, Department of Revenue, Agriculture and Commerce.
„ Adam, Deputy Commissioner of Customs.
Dr. H. Warth, Collector of Customs, Mayo Salt Mines.

Papers were also communicated by the following gentlemen who could not attend personally:—

Mr. Leslie Saunders, C.S., Commissioner of Ajmere.
Lieutenant-Colonel Pearson, Conservator of Forests, North-Western Provinces.
Mr. A. T. Drysdale, Deputy Conservator of Forests, Berar.
„ Max Ferrars, Assistant Conservator of Forests, British Burma.
„ Narayen Bullal Oke, Sub-Assistant Conservator of Forests, Bombay.
„ Narayen Anant Okedway, Sub-Assistant Conservator of Forests, Bombay.

The Conference met at Benmore, Simla.

Wednesday, 6th October. The President (*Mr. Brandis*) opened the Conference with remarks to the following effect:—

It affords me great pleasure to welcome so large a number of Forest and other Officers who have been directed, by the Governments to whom they are subordinate, to meet at Simla in order to discuss important questions connected with the administration of the public forests in the different provinces of India. We owe the institution of periodical meetings of Forest Officers to our friend and colleague Mr. Baden-Powell, who, in December 1870, when acting as Conservator of Forests in the Punjab, held the first forest conference at Lahore. The present is the second general meeting attended by officers from different provinces of the Indian Empire, the first having been held at Allahabad in January 1874. Large gatherings like the present cannot, as a matter of course, be convened frequently, and I shall not therefore propose to the present meeting any suggestions regarding the next conference. On the other hand, we are, I suppose, agreed that in forestry, more than in almost any other profession, it is necessary that all important measures should, in the first instance, be discussed by a number of officers before they are carried out. Our difficulty is that the result of our work does not show at once, and the mistakes we may make in the organization and the treatment of our forests do not, as a rule, manifest themselves until a generation of foresters has passed away, and the work has gone into the hands of new men who had nothing to do with the framing of the original measures. When a railway is built or a canal made it is not generally long

before the main defects of plan and construction manifest themselves; but the effect of a wrong treatment of a forest may not show itself for a long series of years. It is right, therefore, that the decision of a certain class of forest questions should not be left to the judgment of individuals, but that they should be submitted to the discussion in detail of a number of experienced officers. These questions, it is true, are not, as a rule, of such a nature that they can advantageously be discussed by large meetings like the present. A project for the treatment or working of a forest, or the procedure to be observed in effecting the demarcation or the settlement of forest rights, or the grant of forest privileges in any forest district, can only usefully be discussed on the spot by a small number of men intimately acquainted with the details of the case.

There are, however, certain forest questions which will admit of useful discussion by a large assembly; but the main advantage of gatherings like the present is the interchange of actual experience in our work. I for one am exceedingly thankful for the abundant opportunities, which I know this conference will give me, of learning from your experience and of modifying erroneous views which I doubtless have formed on many points owing to imperfect or not sufficiently understood information. This I conceive to be the right spirit in which to commence our proceedings. There is not one among us who might not communicate to this meeting some information gathered from his own professional experience that would be useful and interesting to many of us. An abundance of important communications have been announced, and the only difficulty will be that, for obvious reasons, we can only have a certain limited number of hours for our discussions. In all business the limitation of time is one of the principal difficulties, and we shall doubtless experience it on this occasion. We must therefore endeavour to make the most of our time which can be allotted to each subject, and as it is my duty to preside at this gathering, I request your support generally, and especially as regards the arrangements which I shall endeavour to make to utilise and to economise your valuable time to the utmost.

You are aware that, in accordance with the orders of the Government of India, certain subjects have been submitted for the consideration of special committees, and that one committee will, in consultation with Mr. E. Kellner, Assistant Comptroller-General of Accounts, whom the Government of India have deputed for this purpose, submit definite proposals regarding the system of forest accounts, the classification of budget headings, and the form of annual progress reports; and that a second will discuss the subject of departmental examinations and similar matters. These committees will deal with the questions submitted to them in a precise and official manner, but the discussions at the general meetings will, in accordance with the orders of Government, not have any official character, but be perfectly free and unfettered.

We shall not, I am inclined to think, pass many resolutions at this conference; but I wish to propose, and strongly to recommend for your acceptance, that our proceedings when printed and approved by Government, together with copies of selected Indian Forest Reports and other publications, be sent to some of the leading forest schools and public associations connected with forestry in Great Britain and on the continent of Europe, accompanied by an expression on behalf of this meeting of friendly and cordial greeting and an acknowledgment of services rendered to the development of forestry in India.

This proposition was seconded by Captain Van Someren and carried unanimously.

Mr. Brandis then read the first part of a paper on the "Aim and object of Forestry in India," which will appear in an early number of the *Indian Forester*.

Fire Conservancy.

He then introduced the subject of Fire Conservancy with the following remarks:

Forest administration in India has two main objects: first, the formation, protection and gradual improvement of the public forest domains; second, consistently with the steady improvement of the forests, to make as much timber, wood and other forest produce available as possible for the requirements of the country and for export trade, and thereby to produce from these domains as

large a surplus revenue as is compatible with the maintenance and increase of their productive powers.

We have reason to expect that other advantages besides these named will follow the formation and improvement of the public forests in India. We know that forests have an influence upon the climate, and that in hilly countries the maintenance of well-stocked forests is most beneficial in protecting the loose soil on slopes, in increasing the flow of springs, and in regulating the surface drainage. We are every one of us convinced that we are engaged in a most important work, the full benefits of which will, it is true, not be reaped by the present generation, but which nevertheless will be the certain reward of our labours.

But we are equally convinced that these benefits cannot be secured to the country which we serve if our forests are permitted to remain in the wretched condition in which the great majority of them were made over to our care. A very large proportion of the reserves, when first demarcated, were no better than what our colleagues in France appropriately term "des clairiéres"—vast extents of blanks with here and there groups of scrub and trees. The main cause of this in all provinces of India, except in the evergreen forests of the moister regions and in some parts of the Punjab, are the jungle fires of the hot season, which, in the deciduous forests at least, may fitly be called an annual institution. For the improvement of these forests there is no measure which equals fire conservancy in importance. As long as a forest is burnt annually its improvement is hopeless; its influence upon the retention of soil is inappreciable; and its usefulness in regulating the surface drainage is *nil*. Our hope to make it yield an annual outturn of timber and other produce adequate to satisfy the future requirements of the country will end in disappointment, and the timber which it does yield will always be hollow and rotten. Fire conservancy is at present the most important task of the Forest Department in most provinces of the empire, and therefore we have given it the first place in the discussions at this conference. Ten years ago Colonel Pearson in his annual report almost despaired of keeping out fire from the reserves in the Sátpúra range. In spite of what then appeared as insuperable difficulties, he persevered, and when reading the proceedings of this meeting he will have the satisfaction of learning that the great and good work which was commenced while he was Conservator of the Central Provinces has been crowned with complete success.

Captain Doveton then read his paper on Fire Conservancy as follows:—

On the protection from fire of Forests in the Central Provinces.

THE necessity for adopting measures for the prevention of forest fires was first impressed upon the department by Mr. Brandis, our present Inspector-General. Self-evident as the importance of such measures may now seem, their expediency was at first by no means universally admitted. By some officers doubts were expressed as to the injurious and destructive effects of fires on the young growth, while some went so far as to assert that there were species, such as teak, the seed of which would not germinate unless subjected to the influence of fire, and hence that the prevention of forest fires would result in the annihilation of such species. Forest officers soon became alive to the incorrectness of the views above referred to, but it was not till 1871 that the necessity of this protective measure was universally admitted.

The first attempt at preventing forest fires was made in the Bori reserve in 1865, and in 1867 it was extended to Jagmandal and Chohárigogurh. The expediency of fire conservancy then began to be questioned on the grounds that the results that might be expected would not be commensurate with the expenditure necessary. Time alone could upset such arguments, and thus until 1871 little or no progress was made. From that time the area under protection has steadily increased, till in 1874-75 it amounted to 213,000 acres, of which 164,000 acres were perfectly protected, while in the current year (1875-76) it is proposed to protect a little over 300,000 acres.

Before any method proposed or adopted for the prevention of forest fires can be appreciated, it is necessary to consider the circumstances under which fires originate, and I therefore preface this memorandum by noting some of the known causes of forest fires and the agencies by which they are brought about.

At one time it was not uncommonly supposed that forest fires occurred from the friction of bamboos under the influence of strong winds; but no one who has witnessed the artificial process of obtaining fire by the friction of two pieces of dry bamboo can hesitate to banish this idea without further consideration. Fires may occur through dried or dying trees being struck by lightning, but storms that could possibly result in such accidents scarcely ever occur at seasons when the spread of fire would be possible; and though for many years I have made the origin of forest fires the subject of careful enquiry, in one instance only have I been able to trace it to lightning. Perhaps the first and most important cause is the interest

which graziers have in obtaining an early crop of young grass which induces them to fire the old crop as soon as it becomes dry and inferior as fodder; and next to it comes the interest which the gatherers of forest fruits and flowers have in clearing the ground which induces them to adopt the same course before the gathering season comes round. Burning of the grass is also pursued to render the forests more accessible and to facilitate the removal of produce, to keep off hog and deer from isolated patches of cultivation, and to clear roads leading from village to village. Fires also occur through the negligence of native shikaries, by whom the grass is often wilfully fired to clear away the undergrowth and render it more easy to obtain sight of game, while sometimes the same course is adopted to reduce the risk to human life from wild animals.

It will thus be seen that nearly the whole body of the population in the vicinity of forest tracts have, or imagine they have, a personal interest in the creation of forest fires, and the difficulty experienced in detecting individuals guilty of firing forests without regard to the safety of those belonging to the State is chiefly attributable to this fact. If communities in the vicinity of forest tracts were responsible for damage resulting from forest fires, the latter would rarely if ever occur; but as this is not the case, Government is compelled to adopt preventive measures more or less expensive, the cost of which has to be borne by the public.

The means by which the exclusion of fire has been secured is simply the maintenance of lines round the forests, cleared of all grass and other combustible matter, with a given width free from all deciduous trees, and the periodical employment of guards to check fires which seem likely to send their sparks or flames across the boundary, and to prevent the ingress of men. Though so far the means adopted are everywhere the same, the width of the fire lines, the method of clearing them, and the proportion of watchers engaged vary in different forests. These differences in matters of detail result partly from the local conditions to be dealt with, but chiefly from the constant struggle that is going on to improve the system and reduce the cost of protection to a minimum.

I will now offer a few remarks on the protection of some of the principal forests.

Bori.—This reserve has peculiar advantages which facilitate its protection against fire, though the roughness of the country through which the lines run must render it somewhat expensive. On the extreme west the Sonebuddra river, with a breadth of from fifty to a hundred yards, forms an effectual barrier; on the north the scarps of the Pachmarhi block of the Sátpúra, extending from the Sonebuddra river eastwards, are a source of safety, rendering unnecessary the clearing of fire lines. The protection is further facilitated by the fact that during the time that forest fires generally occur, the prevailing winds are from the west, and therefore it could only be under exceptional circumstances that fire could enter the forest from without. There is, however, one point where peculiar currents, resulting from the topographical features of the country to the north and east, are always a source of danger. At this point fire has twice entered the reserve; but in each case favourable conditions of forest growth below, such as bamboo thickets, under which no grass will grow, have admitted of its being extinguished without difficulty, and before it could extend over more than a small area. The outer fire line actually cleared is 15·19 miles in length, and its width is 60 feet, which is that of the boundary line, on which no tree vegetation is allowed to spring up; 14 miles of road leading through the forest from west to east are also cleared to a width of 15 feet, and 33 miles of foot-paths to a width of 8 feet, but the latter is rather to facilitate locomotion than for fire conservancy. The outer line is cleared by cutting the grass on either side to a width of 4 feet, and burning the stuff, thus cut, with the standing grass on the central portions of the line. The time at which this operation is performed varies in different years, but the burning is carried out, while the fall of dew furnishes a safeguard against the spread of fire; on the internal lines the grass is simply cut and thrown on either side.

Arrangements for the protection of the Bori reserve were first set on foot towards the close of the cold weather of 1865, and at that time there had been no fires in the forest since the spring of 1864. The cost of protection up to date is given in the accompanying statement marked A.

The figures for 1865, 1866 and 1867 cannot now be accurately quoted; they were exclusively for line-clearing, and are known not to have exceeded Rs. 300 per annum. From Statement A it will be observed that from 1867 up to June 1871 there was a steady increase in the cost of protecting this forest, and that from that time it has continued to decrease, till in 1874-75, it was brought down to Rs. 773. The rise in the cost of the work between 1867 and 1871 is to some extent accounted for by the employment of fire guards, which became necessary as the amount of labour employed in the forest decreased, and it is believed that the work was debited with the cost of cutting sub-divisional lines other than those required for protection from fire. The subsequent decrease is not to be attributed to any change in the method of carrying out the work; repeated clearing of the lines has doubtless tended to render the work less costly, but the reduction in expenditure is chiefly due to better supervision and to the transfer of the audit of forest accounts to the Conservator's office.

At the present time the Bori forest is in a perfect state of rest, and no labourers are employed in it on work of any kind; hence the necessity of fire guards at certain seasons. If a regular plan, such as will be required for the regeneration of the forest, had been devised and work were in full progress, fire guards might possibly be dispensed with, and then the expenditure would come down to the simple cost of clearing the boundary line, an item which appears to me susceptible of still further reduction.

Since the commencement of protective measures in Bori, six fires have occurred; the first, and by far the most extensive, resulted from insufficient clearing of the outer boundary in 1865, when fire entered the forest and burnt from 2 to 3 square miles in the south-east corner. In 1866, and again in 1873, a small portion of the forest in the north-east corner was burnt through fire spreading down a certain gorge; in another part on a hill two fires occurred and burnt a small area between 1866 and 1868; one of these resulted from the carelessness of a lunatic who had temporarily taken up his abode on the hill, while the other was the result of a tree being struck by lightning. In 1868 a small fire also occurred at a point where fire had been dropped by a cart-man employed on timber transport. It will thus be seen that of the six fires that occurred, three resulted from insufficient protective measures, two from the carelessness of individuals, while one may be put down to natural causes. They were all extinguished by men employed in the forests either as fire guards, or on timber, or other work.

Jugmandal.—The Jugmandal reserve is a block of about 38 square miles, the length of which is nearly double the mean width. The boundary is for the most part very irregular; but this is to some extent compensated for by the presence of villages on the border, which renders it comparatively easy to obtain labourers for line clearing and men for fire guards.

The system adopted for protection was in every respect similar to that in force in Bori. In the past year, however, an attempt was made to reduce the cost of line clearing, and as a commencement the operation of cutting the grass along the outer edge of the fire line prior to burning was dispensed with. The result as regards expenditure may be seen by reference to the figures in Statement B for 1874-75. With reference to the figures given in this statement it is as well to note that in the past year it was necessary to employ a few extra fire guards in February owing to the survey operations in progress in the reserve. The cost of fire guards for the current year will not exceed Rs. 460. The heavy expenditure at the commencement of protective measures can only be put down to a want of knowledge of actual requirements.

Satpúra Reserve, Korai Block.—As only a very small portion of this forest had previously been protected, it was selected in 1871-72 as a field for experiment in bringing down, if not the total cost of fire conservancy, at any rate that of line clearing. The object of this experiment was to do away with the cost of cutting belts of grass along the boundaries prior to burning. The course adopted was to fire the grass along the boundary in still weather and in the evening shortly before the dew began to fall, and to repeat the operation as often as might be found necessary. In a few instances only, where burroo or other excessively long grasses existed, was the preliminary measure of cutting a line to prevent the spread of fire adhered to. Under ordinary circumstances the regular establishment, aided at times by a few coolies, was expected to keep the fire within bounds. In the first year, 1871-72, owing to the divisional officer's instructions not being fully carried out, the experiment, so far as protection is concerned, failed; but it sufficed to shew that in this way a very considerable saving might be effected. It has since been adopted with most satisfactory results, as may be seen from the figures given in Statement C, under the head of Line-clearing.

Under this system it is necessary to allow from 100 to 150 feet as the breadth of the fire lines, for the clearing will not be so perfect as where cutting is resorted to, and the burning is delayed till all the grass will ignite freely. The width of the lines, too, cannot be so uniform, as a margin must be allowed for control of the fire under the varying conditions which are met with; but 50 feet more or less is a mere trifle on the boundary of a large forest. The increase in the width of the lines is, moreover, no disadvantage, for, in some instances, it is found that not less than 100 or 150 feet will suffice to prevent the passage of fire by sparks. On comparing the charges for fire guards on this reserve with those for the same period and on the same account in Jagmandal, it may be supposed that the less regular clearing of the fire lines necessitates a stronger staff for watch and guard; but this is not the case: Jagmandal is in the wilds of Mandla, where there is little or no traffic, whereas the Korai block is bounded on one side by the great northern road connecting the large stations of Jabalpur and Nagpur, and running through the head-quarters of the Seoni district, and it has another road running through it on which there is much passenger traffic; moreover, in the Korai forest there has not yet been time for the spirit of opposition raised by the exclusion of cattle to subside.

In 1872-73 a few acres were reported as having been burnt, fire having spread farther than was intended when clearing the fire lines; again, in 1873-74 about 480 acres in two separate patches were burnt in the interior of the forest. The origin of the two last fires has not been traced, but they happened shortly after grazing was absolutely prohibited in the protected block, and are supposed to have been the work of disaffected gaolies. No other fires have up to the present time occurred, and the protection of the forest for the past three years must be considered complete.

For the present the figures for this forest fairly represent the rates at which, in the Central Provinces, the protection of forests from fire should be secured. Under the arrangements projected and carried out under the direction of Mr. McKee, Assistant Conservator, the cost has been brought down to Rs. 11-10-4 per square mile of forest and Rs. 11-8-6 per running mile of boundary patrolled.

As the height of the grass in and around the forests is the principal thing by which the difficulty or otherwise of protection is governed, it is necessary to note that in the forests already referred to the height of the grass runs from 1½ to 4 feet, which it only exceeds in very exceptional localities.

Bemaram Forest, Ahiri.—As up to 1873-74 only half the area of this block was protected, it is at present scarcely possible to draw from the actuals up to date any satisfactory conclusion regarding the cost of protection; but the work here has been more costly than elsewhere, and therefore in striking averages for the province it is reasonable to take the charges for this forest into account; moreover, I believe that the conditions to be dealt with in Ahiri resemble those to be met with in Bengal and Burma and parts of the North-Western Provinces, and therefore a short account of its protection may be of interest to officers of other provinces.

The Bemaram block in Ahiri is a long strip of forest only 19¼ square miles in extent, and enclosed within a boundary 28½ miles in length. The protection of Ahiri is rendered costly by the heavy crop of burroo and other tall grasses which spring up annually and render the use of fire as an agency to line clearing impossible. The height of these grasses varies, according to species and locality, from 4 to 10 feet. The course adopted has been to first clear by cutting a strip 20 feet wide and to crush the taller grasses over a further width of 60 feet prior to burning. The crushing is effected by men who carry in a horizontal position heavy poles about 10 feet long which they throw before them, thus crushing down the grass on an area of about 20 square feet at a stroke. The advantage of this arrangement is that it ensures the more perfect burning of the grass on that portion of the line not cut than could be secured by simple burning, while the flames are prevented from rising to the same height that they would do if the grass were burnt standing. This experiment was not attempted till last year, and the data as yet available regarding the cost of the operation is by no means to be depended upon, but it is estimated that in the manner discussed one man will crush and lay flat on the ground the grass on 1,100 square yards in one day. It cannot, however, be applied except where the grass is of considerable height, and the stalks are disposed to be brittle.

Prior to 1874-75 the grass was burnt off the outer portion of the line without crushing after cutting over the inner width of 20 feet; but except where the shorter species of grasses existed, this course was found to be attended with too great risk and had to be abandoned. The height of the grass in Ahiri and the proportion of the boundary to the area is sufficient to account for the comparatively high cost of protection, details of which will be found in Statement D. In spite of all precautions, fire has more than once entered the forest under protection: in March 1872, before the clearing of the line across the Bemaram hill had been completed, fire spread down the ridge and soon spread over the entire area; in 1873-74, fire was blown across the western boundary into the forest, but it was soon got under and 150 acres only were burnt; and again in 1874-75 fire spread from the new line that was being cleared and burnt about 360 acres.

Trifling as the failures herein noted may be, they suffice to shew that, under the present system, perfect safety against fire is not secured, and I will endeavour to shew further on how protective measures may be rendered more complete.

As already explained, the present system is to disconnect the area to be protected from the surrounding country by cleared lines, and to prevent the ingress of man by maintaining an establishment for watch and guard. It has also been shewn that the width of the fire lines must to some extent depend on the class of vegetation through which they run; but there is another important point by which this must be regulated, *viz*, the direction of the prevailing winds. When the fire lines run at right angles with the prevailing winds, a much greater width is obviously necessary than when they follow the course of the winds, and for this reason, when a forest is sub-divided for protection from fire, the sub-division lines should, if possible, follow the course of the prevailing winds. The value of the tops of ridges as fire lines cannot be over-estimated; if burnt to a short width on either side they form an impassable barrier to fire. The check of fire might be facilitated by the establishment of evergreen belts, but, excepting where the country outside the boundary is clear and open, this would render more difficult the watch and guard of the lines; if, however, the evergreen belt be supplemented by a strong living fence, this difficulty would be removed and protection would be reduced almost to a certainty. Such a system could not, however, be introduced in forests frequented by wild elephants or other heavy animals.

To ensure the regular patrolling of fire guards, the system adopted in Ahiri of issuing passes distinguished by serial numbers and the date of issue to be passed on from watcher to watcher till they return to the starting point and are made over to the subordinate by whom they are issued commends itself to notice. They may be issued at intervals varying according to the length of line each watcher has to patrol, and the length of line, and the hours at which each portion has to be patrolled being known, the time at which the passes are returned would indicate the regularity with which patrolling has been performed.

As regards the system of remunerating fire guards for their services, I would recommend low monthly pay and rewards for success at the end of the season. This system has worked well in the Sátpúra reserve in the Central Provinces.

The object of preventing forest fires is known to all forest officers, and therefore I have not adverted to it in this memorandum; moreover, the subject could scarcely be touched upon without shewing how far the end has been attained, a subject which belongs more properly to natural reproduction.

STATEMENT A.

Details of expenditure on the protection from fire of the Bori Reserve; area, 37 square miles; length of boundary, 28·25 miles.

Year.	Length and breadth of the outer boundary cleared as a fire-line.	Length and breadth of interior fire-lines.	Average number of fire-guards employed.	Cost of line clearing.	Cost of fire guards.	Total.	Cost per square mile	Cost per running mile of fire line cleared and patrolled.
				Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1868	15·19 miles × 60 feet	None, the repairs to the chief roads being considered sufficient.	*Nil*	228 13 0	*Nil.*	228 13 0	6 2 11	.....
1869	Ditto		..	378 0 0	..	378 0 0	10 3 5	
1870	Ditto	14 miles × 15 feet	...	1,455 0 0	..	1,455 0 0	39 5 2	... .
1871 to 31st March	Ditto	Ditto	12	1,295 0 0	77 13 4	1,372 13 4	37 1 7	.. ..
Total outlay up to 31st March 1871			...	3,356 13 0	77 13 4	3,434 10 4	92 10 1	.....
1871-72	15·19 miles × 60 feet	14 miles × 15 feet	46	642 11 2	1,081 0 0	1,723 11 2	46 9 4	59 0 2
1872-73	Ditto	Ditto	28	338 10 6	537 8 4	876 2 10	23 10 10	30 0 0
1873-74	Ditto	Ditto	23	293 8 0	526 1 6	819 9 6	22 2 4	28 1 11
1874-75	Ditto	Ditto	23	277 3 3	495 14 0	773 1 3	20 14 3	26 11 8
Total for the past four years			...	1,552 0 11	2,640 7 10	4,192 8 11	113 4 9	143 13 9
Average for the past four years			...	388 0 3	660 1 11	1,048 2 2	28 5 2	35 15 5

STATEMENT B.

Details of expenditure on the protection from fire of the Jagmandal Reserve; area, 38 3 square miles; length of boundary, 41 miles.

Year	Length and breadth of the outer boundary cleared as a fire line.	Average number of fire guards employed.	Cost of line clearing.	Cost of fire guards.	Total.	Cost per square mile.	Cost per running mile of fire line cleared and patrolled.
			Rs. A. P.	Rs A. P.	Rs A. P.	Rs. A. P.	Rs. A. P.
1868	41 miles x 60 feet	The number of fire guards employed during these years cannot now be accurately ascertained.	705 8 0	2,351 4 0	3,056 12 0	79 12 10	. ...
1869	Ditto		824 0 0	3,045 0 0	3,869 0 0	101 0 4	.....
1870	Ditto		1,005 7 3	2,362 0 3	3,367 7 6	87 14 5	.....
1871 up to 31st March	Ditto		919 14 4	581 0 0	1,500 14 4	41 3 2	....
Total outlay up to 31st March 1871	..	. ..	3,454 13 7	8,339 4 3	11,794 1 10	309 14 9	.. ...
1871-72	41 miles x 60 feet	60	335 7 2	1,278 10 0	1,614 1 2	44 6 5	39 5 10
1872-73	Ditto	30	501 10 0	437 8 0	939 2 0	24 11 2	22 14 5
1873-74	Ditto	30	325 11 9	515 12 2	841 7 11	21 15 6	20 8 4
1874-75	Ditto	30	182 8 0	559 1 0	741 9 0	19 5 9	18 1 4
Total for the past four years	.....	.... .	1,345 4 11	2,790 15 2	4,136 4 1	110 6 10	100 13 11
Average for the past four years.	.....	.....	336 5 2	697 11 9	1,034 1 0	27 9 8	25 3 5

STATEMENT C.

Details of expenditure on the protection from fire of the Korai Block, Sátpúra Reserve; area 49 square miles; length of boundary, 42 miles.

Year.	Length and breadth of the outer boundary cleared as a fire line.	Length and breadth of interior fire line	Average number of fire guards employed.	Cost of line clearing.	Cost of fire guards.	Total.	Cost per square mile.	Cost per running mile of fire line cleared and patrolled.
				Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
1871-72	42 miles × 100 feet	7½ miles × 100 feet	50	49 2 0	372 15 10	422 1 10	8 9 10	8 8 3
1872-73*	Ditto	Ditto	50	78 15 0	421 8 2	500 7 2	10 3 4	10 1 8
1873-74	Ditto	Ditto	50	52 4 0	748 5 4	800 9 4	16 5 5	16 2 8
1874-75	Ditto	Ditto	30	45 3 0	525 10 3	570 13 3	11 10 4	11 8 6
Total for past four years	...	.....	...	225 8 0	2,068 7 7	2,293 15 7	46 12 11	47 5 1
Average for past four years	.....	...	...	56 6 0	517 1 10	573 7 10	11 11 2	13 10 5

* The expenditure represents the cost of protection from 1st June 1872, the forest having been burnt in the previous year.

STATEMENT D.

Details of expenditure on the protection from fire of the Bemaram Forest, Akiri; area 19·2 square miles; length of outer boundary 28½ miles.

Year.	Length and breadth of the outer boundary cleared as a fire line.	Length and breadth of interior fire lines.	Average number of fire guards employed.	Cost of line clearing.	Cost of fire guards.	Total.	Cost per square mile.	Cost per running mile of fire line cleared and patrolled.	Area under protection.	Area actually protected.
				Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.		
1871-72 . . .	18 miles × 100 feet .	*Nil.*	None.	229 7 5	*Nil.*	229 7 5	11 15 2	.....	6,467 acres	*Nil*
1872-73 . . .	Ditto . .	7 miles × 15 feet .	Ditto	246 7 2	Ditto.	246 7 2	24 6 5	.....	Ditto	6,467 acres
1873-74 . . .	Ditto . .	Ditto . .	10	163 13 6	260 14 5	424 11 11	42 0 10	16 15 0	Ditto	Ditto.
1874-75 . . .	28½ miles × 100 feet.	Ditto . .	20	369 1 1	452 12 1	821 13 2	43 2 0	11 9 2	Whole area.	Whole area.
Total cost . .	.....	.....	...	1,008 13 2	713 10 6	1,722 7 8	121 8 5	28 8 2	.....	.....
Average cost . .	.....	.....	...	252 3 3	356 13 3	430 9 10	30 6 1	14 4 1	.....	.....

Dr. Schlich asked Captain Doveton to explain how the expenditure had been reduced since the audit of forest accounts had been placed under the Conservator. *Captain Doveton* replied that formerly, when the bills were sent direct to the Accountant-General, the Conservator had no control over the expenditure, and knew little or nothing about it. *Dr. Schlich* said that in his opinion the more men there were at work in the forest, the more watchers would be required to prevent fire. *Captain Wood* disagreed, and said that in one portion of the Oudh forests he had had a great many men at work from February to May and that no fires had occurred. With reference to the direction of the fire lines, he would lay them out at right angles to, and not in the same direction as, the prevailing winds, as then the burning of counter-fires would be facilitated. *Mr. Wallinger* thought that fire guards could be dispensed with if two evergreen fences were planted and the intermediate space sown with some thickly-growing scrub; for, if the first hedge failed to arrest the progress of the fire, the second would be effective in doing so. *Mr. Amery* remarked that fires frequently originate in the interior of the forest, and hence we could not entirely dispense with fire guards. *Mr. Mann* said that the support of civil authorities was most necessary, and it was to this that he owed his chief success in Assam. *Major Waterfield* asked how the civil authorities were to help. *Mr. Mann* replied that they could help by earnestly enquiring into the origin of forest fires. *Dr. Schlich* quoted the case of Bengal, where a dense cane-brake, 150 feet broad, was not sufficient to keep out fire, and hence in his opinion fire guards could not be dispensed with. *Captain Campbell* enquired as to what was practically the best size of the blocks; but no definite answer could be given to this question as it depended on the number of villages and the number of roads open for the passage of the public. *Captain Doveton*, however, thought that it was easier to preserve large areas, but in that case he would have a series of subordinate lines. *Mr. Gibson* asked what length of line one man could effectually patrol, and whether the men were paid in cash or otherwise. *Captain Doveton* replied that one man would look after 2 miles of line, and that they were paid in cash. *Mr. Mann* said that he employed one man to every 6 running miles of fire line. *Mr. Amery* stated that the men employed to cut the fire lines were also the guards, and that he retained one-third of their pay until fires had been effectually kept out.

Mr. Brandis said that it was most important to keep out fires from our forests, though it had been the custom of the country for ages to set them on fire. It would seem at first sight a cruel measure of conservancy, as the people were accustomed to burn the forest in order to obtain better pasture for their cattle. The question, however, could only concern the imperial reserves which form but a small proportion of the forest area. Thus in the Central Provinces these reserves only amounted to 2,270 square miles, or about 2·7 of the total area of the province; in the North-Western Provinces they amounted to 2,400 square miles, or nearly 3 per cent. of the total area; and generally throughout India the reserves hitherto demarcated formed from 1 to 4 per cent. of the total area of the province in which they are situated. It would be impossible to keep fire out of the whole forest area, and the difficulties were so great that every step in the matter required most careful consideration. Were we not absolutely certain that forests cannot improve without strict protection from fire, and were we not convinced of the necessity of providing for future wants, not for railways and canals, but for the needs of the agricultural population, when all else is exhausted, then fire conservancy could not for a moment be thought of. In European forests most mature trees are sound, but in Oudh only one in three full-sized sâl trees is sound, and a similar proportion of unsound timber is the character of most Indian Forests. The cause of this is manifold. The bark is charred and the wood exposed. The young seedling is burnt down again and again, the charred stump remains exposed, is afterwards covered with new wood, and the result of this is a hollow tree. We cannot expect our forests to yield a sufficient supply of timber, bamboos, grass and other forest produce without increasing their powers of production, and it is impossible to effect this unless we keep out fires; for our reserves, then, we have no alternative but their strict protection from fire, and we are thus justified in making our arrangements as perfect as possible. In the south of France, in Provence, there are extensive forests of

cork oak and *Pinus Pinaster*, mostly the property of private proprietors; there is a dense undergrowth of tall heather which catches fire as easily as grass and dry leaves in India. In these forests fire is a great enemy, and the rides and cleared fire-lines hitherto tried have failed in many cases; so the latest protective measures introduced as an experiment consist of broad belts of evergreen trees, and it is hoped that they will prove successful. It is certain that, where the ground is moist enough, such belts form an excellent protection; but it is a very difficult matter to raise them in the hot and dry parts of India. In North and Central India we have some evergreen shrubs, but the dry leaves that fall would have to be swept up constantly. It is by no means sure whether broad lines kept perfectly clear are not the most effective plan.

Captain Wood remarked that evergreen hedges would take some time growing, and inquired how long it would be before they would be high enough to prevent fire passing over. *Mr. Wallinger* stated that *Opuntia vulgaris** (the prickly pear) was admirably adapted for hedges, as it grew up at once. *Mr. Brandis*, however, thought that the prickly pear was useless in keeping out fire. Though a succulent plant, it was easily burnt, and it had failed in the Dekkan along the Great Indian Peninsula Railway, where miles of it had burnt owing to the grass which grew up among the stems. *Mr. McKee* was also of the same opinion; but *Mr. Wallinger*, supported by *Mr. Shuttleworth*, stated that it had answered remarkably well round plantations in the Bombay presidency, and that by its means fires had been effectually kept out. *Mr. Brandis* observed that this was a most interesting communication, as he had always thought that the grass under the cactus hedge led to its being easily burnt. *Mr. Shuttleworth* thought that the large area sacrificed in burning these fire-lines was not commensurate with the good done to the forest; but *Mr. Brandis* was entirely opposed to this notion, and said that we *must* sacrifice a certain proportion of forest for the good of the rest. There were many patches where the cover overhead was so dense that fires could scarcely occur, and there was no doubt that, with the improvement of the forest growth, the date when the risk of fire commences will be retarded, and the period of duration of this risk will be shortened. *Mr. Shuttleworth* remarked that if a living hedge, which might also be useful in yielding some forest produce, could be substituted for these fire-lines, it would be a great gain.

Captain Wood then read his paper as follows :—

Roads and fire conservancy.

The object of fire conservancy is to preserve and improve the present stock of timber, and to allow the reproduction of a new growth of young trees.

2. By keeping fires out of a forest, the decaying leaves, grass, and other vegetable matter, make a coating of light porous material, which keeps the surface of the ground at an even temperature, and allows falling seeds to germinate, and at the same time supplies food to the innumerable rootlets of the side roots of the larger trees. The porous coating retains the moisture, which it gives off slowly, absorbing it again from the atmosphere. The rain is allowed to percolate into the soil, carrying with it the food of plants contained in the vegetable coating, laying up a stock of moisture and nourishment which is available when the trees require it. The trees grow in a natural manner, and the timber produced is sound and valuable.

3. But when fire enters a forest, it burns all the dry standing grass and the fallen leaves and other vegetable matter, baring the ground to the sun's rays; and it burns entirely the sickly and dead trees, old and young, which have been weakened or killed by former fires, and it damages those of a healthy growth, and particularly the young. The soil is baked and hardened, and no moisture is either retained or absorbed; and the rain when it comes does not percolate through the soil, carrying with it the food of plants in the shape of ashes in solution, but runs off the hardened surface into the watercourses and rivers, where it is lost to the trees. The vegetable and porous covering being removed, there are few places for the seeds to fall into and get covered; and the seedlings, even if they do spring up, seldom arrive at maturity, but die off from want of food and moisture. The destruction of dead timber is very great, and the effects on the growing timber are deplorable, the timber being unsound; and no one can tell the amount of damage done till they have cut up the timber, perhaps not getting even one-half or one-third of the gross quantity of good timber.

4. Why allow fires? In ignorant communities immediate personal gain is everything; imprudently and selfishly, there is no thought of others for the present, or of the interests of themselves, or of others, for the future. The herdsman, who wants to get up a crop of fresh grass for his cattle, sets fire to the dry grass; he gets a few acres of the fresh grass he requires; he cares not if the trees on a thousand times the area he wants are destroyed. The villager who

* *Opuntia Dillenii*, Haworth, a plant introduced from America and often erroneously called *Opuntia vulgaris*.—D B.

wants to pick up a few sticks for fuel, or cut some wood for farm or domestic purposes, prefers that the whole forest should be burnt than that he should have the trouble of searching for what he wants among the long grass and thicket of seedlings. The cultivator in the vicinity of the forest prefers that a whole forest should be burnt than that his portion of an acre of rice or wheat should suffer from the game which the grass and thicket of seedlings give shelter to. People who have to pass through forests like the whole forest to be burnt, and the ground bared, so that they may have no chance of meeting dangerous wild beasts. The collectors of timber for sale, the collectors of wild flowers, fruits, gums, honey, wax, &c., like the grass and seedlings burnt, that they may collect these things with little trouble: in fact, it may be said that it is the immediate interest of the population in the vicinity of the forest, or rather that they think it to be so, that the forests should be burnt. There is plenty of timber now for them; but how about the future interests of the population in the vicinity of the forests, and the present and future interests of the community in general?

5. In time, the constant firing of the forests will destroy the vegetation and deprive the people inhabiting the neighbourhood of what once were forest lands, of most, if not of all, of the products which their forefathers so wantonly wasted.

6. With the general community how do matters stand at present? With a forest area which, if it had been properly managed, could have largely supplied the wants of the public; with a rich soil; and with a climate which is more favourable to vegetation than the climate of Europe: there is a timber famine in India. For building purposes good timber is dearer in India than in England, though the price of labour is about one-tenth in India of what it is in England, and the value of land is in somewhat the same proportion. The poor man in cities has to spend about one-eighth of his pay to buy wood to cook his food with, and I have seen (at Agra) charcoal and wheat about the same price. For railway sleepers, American or European timber is creosoted in Europe, sent by sea to India, carried hundreds of miles by land carriage, and yet undersells the sleepers of Indian wood. Iron girders, made in England and costing much for carriage, are used in large public buildings instead of timber beams; and on the railways, though wooden sleepers are for many reasons preferable to iron ones, the latter are used, either because wooden ones cannot be obtained, or are too expensive.

7. Owing to forestry not having been sufficiently appreciated; to people thinking that what is, is best; to the natural desire of rulers not to interfere with the customs of the people, harmful to others though they be; and to the rage for extending cultivation, the wants of the community for timber, fuel, and pasturage not having been properly understood, the destruction and wholesale firing of forests has, till very lately not been interfered with; indeed, they have been advocated by persons in power who, otherwise good administrators, were mistaken in forest matters: but their day is gone, and now there is no doubt in the minds of able administrators that firing in certain portions of forests must be prohibited.

8. The area of forests at present protected from fire is very small, and the closing of portions of forest against grazing and its concomitant evil, jungle fires, must necessarily be gradual, and it is hoped that in years to come the public generally will be better off, as regards timber, fuel, and pasturage, than they are at present.

9. In commencing operations for fire conservancy, the formation of straight roads (which are also useful for purposes of inspection, of export of forest produce, of police, of the convenience of the neighbouring population, and of the formation of blocks and compartments) is, I consider, the first thing to be taken in hand.

10. These roads must be always kept cleared of dry grass and leaves in the hot season. In forests also where water cannot be easily obtained, wells should be dug alongside the roads, or better, at the junction of two or more roads. These wells are useful for parties working in the forests, for travellers, and for the fire-watchers who are posted in the forests during the dry months, when the forests are liable to be burnt.

11. In laying out these roads many circumstances have to be taken into consideration. Many of these roads should be at right angles to the direction of the wind prevailing in the hot season, in order that, though a certain block of the forest catches fire, the fire may be intercepted at the cross roads. Captain Doveton advocates fire-lines being in the direction of the prevailing winds, but I think there is great advantage in burning back and sacrificing one block for the safety of the many. Important villages on opposite sides of the forest should be connected, and, as people must pass through the forests, it is better that the traffic should be drawn on to the lines, for constant traffic has the effect of killing down the long grass, which is replaced by a finer variety; and this grass helps to keep fires from crossing the line, and the forest officers can close the narrow winding path, where people cannot be watched, for in a straight, clear road people can be seen for a long distance. Blocks and compartments, of sizes suitable for timber operations or other purposes, should be formed. The general direction of traffic should be studied, as also the nature of the ground, so as to get the roads on lines that will be well used, and where there are not too many ravines or watercourses to make the road too expensive to keep in good order.

12. I now produce some maps shewing lines which I have made in the Kheri and Bharaich divisions of the Oudh forests, and which already have proved of much use.

13. At first I cut my main lines 100 feet broad, dividing the division into subdivisions or ranges, and other lines I cut 50 feet broad, marking the ranges off into blocks; but I found the expense of keeping the lines clear so great that I thought it better to have a well-cleared line in the centre, which I could use as a driving road. These roads have been marked off with a *dagkbel* (small trench) 6 inches deep, all stumps of trees and large grass roots extracted, and the grass cut. These roads are now in such good order that I can on most of them drive a dog-

cart at a good pace either by night or by day, and I and my officers are enabled to get over long distances quickly, reserving the slow-moving elephants for actual inspections in the interior of the blocks, where inspection on foot or horseback would be slow, if not useless and dangerous.

14. It will be seen in the Kheri map that my principal lines converge on Dudua, which is on the edge of the high sál land, and near which a temporary bridge is yearly built over the Sohelee (at Dudua Ghát), and the road on emerging from the forest is continued with the aid of the district authorities to the town of Pullia, from which we draw our supplies, as the villagers in the vicinity of the forests are for the most part a pastoral people and have little grain to supply our working parties, which, in the cold weather, when we are in full work, often number above 3,000 men. It will also be seen that the cross roads are at right angles to the north-west wind, which is the prevailing hot wind, and that the roads lead to the Sohelee river, down which our timber is rafted, and then down the large river, the Korially, to the principal timber market in Oudh, Báhramghát, about 200 miles distant.

15. The roads in the eastern subdivision are not yet complete, but will be laid out in the best manner suited for the working of the forests and general convenience: thus, some roads will be directed on the Mohan river, where it is suitable for rafting; some to the main river, the Korially, where land carriage to it direct may be preferable to using the smaller rivers, which may not be navigable during the dry season: while others again in the south-eastern part will lead to the Sohelee river.

16. In the Motihar subdivision (or range) of the Bharaich division, the cross roads, nearly at right angles to the main road; which runs north-west, will be made to converge on Sujoulee on the Korially for the northern section, and on Simree Guttai, also on the Korially, for the southern section, there being a large swamp opposite the forests between Sujoulee and Simree Guttai; other roads will be made to the Chota Surjoo river, which afterwards meets the Korially where land carriage is too distant to the Korially direct.

17. In the Bhinga subdivision (or range) the Churdo section or forest is cut up from the centre, allowing very perfect inspection and protection. This forest has been preserved from fire for some years. It is surrounded by cultivation, and the coarse grass is principally in the broad treeless depressions which run through the forest. The forest is principally composed of young sál poles, the superior growth of which, owing to the exclusion of fires, is easily seen. The Bhinga forest of about 60 square miles, divided into two sections, is surrounded by cultivation, and the grazing requirements that we have to supply are very great. The grass is short owing to the grazing, the main road traverses the whole length of the forest running north-west, the cross lines join the opposite villages, and will allow produce to be taken to the river Rapti, which opens out a different market to that of the Korially. At the junction of the cross roads, generally in groups of six in this forest, wells have been made or are in course of construction and houses have been made where watchers are stationed. In course of time, if necessary, produce removed by purchasers can be ordered to be taken out by certain roads, and at the forest boundary toll houses can be established.

18. With regard to the lines which were cut 100 feet and 50 feet, with the 15-foot road in the centre, we cut the grass from the road, placing it on both sides, and when dry enough we burn it. The fire communicates with the grass on either side of the road and does not enter the forest, in which the grass is green, owing to the shade of the trees; whereas the belts that are open to the sun generally burn, but the coppice growth that has sprung up prevents the burning from being regular and certain. We must burn rather early in the season, as, having no cut line towards the forest, the fire would enter the forest if the grass under the trees were dry.

19. I now cut my lines only 20 or 15 feet broad or less according to circumstances, such as luxuriance of the grass, traffic, &c. These roads are shady, and will become more so when the trees close in overhead; thus, the grass is easily kept down, whereas in the broad clearing of 100 feet and 50 feet sunlight is admitted and the grass grows luxuriantly.

20. I now propose, in places where I was afraid of fire crossing a 20-foot or 15-foot line, making a bridle path about 8 feet wide, parallel to the driving road and ranging in distance from 50 to 100 feet according to circumstances, trenched on each side, in the forest. This will be a shady riding path, the grass cut from the road being placed on the side nearest the path, and that from the path on the side nearest the road. By this method I can burn the grass on the strip between the clear lines later in the season than I can under present circumstances, making certain of having a clear burnt space between the two lines; for, having trenched lines cleared of grass, with a proper number of men along the lines, and burning at the right time and season, I can confine the burning to the strip required.

21. In cutting these lines, as I want them for roads, I cut round the roots of the trees and let the falling tree by its own weight pull out the remaining roots. This I find much cheaper than first felling the tree and then digging out the stumps.

22. In cutting the 100-foot and 50-foot lines I cut everything at 2 feet from the ground. By counting the stumps and at the same time noting the species and diameter I have the very best of linear valuation surveys: this plan might be adopted where the valuation survey was of more importance than the difference of cost between the two methods.

23. I annex two papers shewing the arrangements proposed by the Inspector-General of Forests during his recent visit to the Oudh forests, which were carried out with satisfactory results during the last dry season.

24. The utility of having numerous roads which act also as fire-paths is very great. The forest can be cut up into numerous blocks and compartments, which can either be protected from fire or given up for other purposes, as the nature of the ground, the growth of the forest, or the requirements of the people may demand. Lands for grazing can be marked off where

the firing the grass will do no damage, and where we can get a legitimate revenue from grazing (at the same time protecting other parts of the forests where it is desirable), and where under a proper system of firing a constant supply of young grass can be obtained, and a small area be made to yield a larger amount of edible grass than a larger area fired indiscriminately. The villagers, who want wood for fuel and for building, need not overcut near their own villages, or go through dense forest to gather what they require. The cultivators can form hedges along the exterior lines and prevent the game coming on their fields, and persons passing along the broad clear lines during the day-time have little, if anything, to fear from wild beasts. The collectors of forest produce can also take out what they require with greater ease to themselves, though of course in the blocks the forest will be dense; by the number of roads they can take out more produce, and good yielding localities will be made better known.

25. And, as a person who farms an estate properly, does not allow his sheep and cattle, from which he makes great profit, to feed when and where they like, but keeps them to certain pasturages, and does not allow them to browse on the young turnips and grass, which, when mature, will form their food for the winter, nor to trample down and destroy the corn, the straw of which is to be used for their bedding, and the grain to form his profit, so by a proper system of management the Government of India in the Forest Department, by allotting certain portions of forest for specific purposes, will give to the people at large great benefits, give a greater outturn of produce than could be obtained without imposing restrictions, and at the same time obtain a fair money return, which is used for the benefit of the general public.

26. I am afraid I am leaving mention of two great aids to conservancy against fire to my last paragraph. Those two great aids are the help of the district officers and of the people themselves; but till we have made known what we want to preserve from fire, and what we can afford to give up for purposes other than the growing of timber it will be difficult for either to help us greatly, and I trust that I have made out my case, that the formation of roads, where it is possible to make them, is the first step in preserving the forests from fire, and consequently of forest conservancy. I am afraid also that I have been telling you many things that you know as well as, if not better than, I do; but, as these papers read at the conference may also hereafter be read by district officers, I hope that they, knowing what we have done and are doing, will do all in their power to help us, and by their influence aid us in obtaining the help of the people themselves, for whose benefit we are administering the forests in India.

FIRE CONSERVANCY OF THE CHURDA RANGE.

(AREA ABOUT 10 SQUARE MILES.)

Head-quarters of forester and of 2 fire-watchers at Abdoolla Gunge.

Post No.	I. Doondra Junction, 3 lines	...	2	fire-watchers.
„	II. Nipal Frontier ...	...	2	„
„	III. Khyrunian ..	...	2	„
„	IV. Sisuyan ...	...	2	„
„	V. Hurbunsee Deeh	...	2	„
„	VI. Toolsee Deeh	...	2	„
„	VII. Sonepur Junction	...	2	„
„	VIII. Jilwa ...	...	2	„
	Total	...	16+2=18 forest-watchers.	
			@ Rs. 4=Rs. 72 per mensem.	

From 23rd March to 23rd June, or the setting-in of the rains, say 3 months, at Rs. 72 per mensem = Rs. 216.

1st Post.—Doondra Junction. Charge from Suntullia fire-path on the east to Doondra Nala on the west, and Suntullia fire-path, Golal Deeh fire-path and north road from Doondra Nala to Nipal frontier.

2nd Post.—Nipal frontier. The fire-watchers will have charge of the whole frontier line, and it is the fire-watchers' duty to see that fires do not cross from Nipal.

3rd Post.—Khyrunian. Charge, Khyrunian—Abdoolla Gunge fire-path on the south, Doondra Nala on the east, and cultivation on the west. Nipal boundary on the north. The fire-watchers will have charge of the north line from Doondra Nala to Abdoolla Gunge and Abdoolla Gunge Khyrunian fire-path.

4th Post.—Sisuyan. Charge, Khyrunian—Abdoolla Gunge fire-path on the north, Jubdee Nala on the east, cultivation west and south.

5th Post.—Hurbunsee Deeh. Charge, Jubdee Nala on the north-west, Doondra Nala on the east, cultivation on the south. The fire-watchers will have charge of south line from Abdoolla Gunge to Hurbunsee Deeh.

6th Post.—Toolsee Deeh. Charge, Doondra Nala on the west and south, Abdoolla Gunge Sonepur line on the north-east. The Abdoolla Gunge Sonepur line will be in the charge of the fire-watchers of this post.

7th Post.—Sonepur Junction. Charge Abdoolla Gunge. Sonepur line on south-west, cultivation on the east. Abdoolla Gunge Badee Deeh on the north-east. The fire-watchers will have the charge of the Abdoolla Gunge Badee Deeh line.

8th Post.—Jilwa. Charge, Suntullia fire-path and post-line from Abdoolla Gunge to Doondra junction on the west, on the north Nipal boundary, on the east cultivation, on the south Abdoolla Gunge Badee Deeh line. The principal work will be on the boundary adjoining cultivation.

On the Nipal frontier line, the line must be thoroughly cleared and burnt over; on the 50-foot roads grass must be burnt on the fire-paths, leaves must be swept off the roads or collected and fired when there is no danger of the fire communicating to the leaves and grass inside the forest. On all lines or fire-paths all inflammable matter must be either burnt off, or removed when it is not possible to burn it.

All persons entering the forests should be warned against either lighting fires, except at Abdoolla Gunge in a place set apart for the purpose, or conveying fire carelessly. In case of large parties of travellers passing through, they should be accompanied till they are out of the forests.

FIRE CONSERVANCY OF THE DUDUA RANGE.

SOHELEE RIVER, ABOUT 10 MILES.

Outside Land Boundary.

Sohelee river, about 10 miles.			
No. 2 Sohelee line	2·3 miles.		
Main Goareeghát line ...	1·7 „		
Line to Phulwarria	1·6 „		
Phulwarria to Musankhum ...	1·3 „		
Musankhum to Budronla ...	2·1 „		
Budronla to Main Bhadi Tal line .	3·0 „		
Pallia line	1·4 „		
Jumna Phanta	1·5 „		
		14·9 miles.	

Internal Lines.

No 1 Sohelee	2·7 miles.		
Suthiana road	5·0 „		
Newia junction line ...	1·2 „		
Plantation line ..	0 6 „		
Goareeghát line	2·8 „		
Phulwarria line ...	2·8 „		
Musankhum line	2·3 „		
Budronla line	2·8 „		
Main Bhadi Tal line	4·0 „		
River line	4·0 „		
Palha road	0·6 „		
1 Mile Bhadi Tal junction line ...	0·5 „		
		28·8 miles.	
		43·7	
Bazar Line .		1·3	
Total ...		45 miles.	

Establishment for 3 months.

1 Ranger on Rs. 20, head-quarters Dudua, with 6 men.

Post No.	I.	3	Fire-watchers on Rs. 5 each at	Kurguttia Ghat.
„	II.	3	„ „	„ Chandpara well.
„	III.	3	„ „	„ Tiger well.
„	IV.	3	„ „	„ No. 1 junction.
„	V.	3	„ „	„ Suruta Phanta.
„	VI.	3	„ „	„ Musankhum ditto.
„	VII.	3	„ „	„ Bhudronla ditto.
„	VIII	3	„ „	„ Pallia ditto.
„	IX.	3	„ „	„ Jumna Gouri.
„	X.	3	„ „	„ Bridge.

2 men to act as patrols and 1 man to remain at each chokie.

1 man at chokie to warn all travellers about fire as they enter the range.

2 men to cut grass, and take leaves off road, burn them when they can, and make every arrangement to stop fires.

To start with, the lines must be cleared of grass by a working party (in which the 2 men must help), 100 feet wide, including the 15-foot road, the grass when dry to be burnt on a still day, not to let fire enter green forest. All *phantas* (open grass places) must be burnt as soon as possible; any small *phantas* or open places adjoining the 100-foot clearing must be burnt as soon as possible. The trees on the 100-foot clearing need not be cut over, only the grass; the injury done to the young trees on the 100-foot clearing need not be thought of.

Chuppur huts should be made at the posts, and where there is no water kutcha wells dug. The ranger to do no other work but fire conservancy. A 100-foot line to be cleared and burnt round the bazar.

Mr. Brandis said that the Oudh fire-lines had been laid out with great skill so as to serve as lines of export and to be kept clear by traffic, before fire

conservancy was attempted; in most forests they were arranged so as to radiate from a point, something like the old *Carrefours* in the French forests. This system could only succeed in tolerably level country, but it was one that deserved to be well understood. *Mr. Greig* described the system of burning fire-lines along the ridges in Mandhol. *Major Waterfield* stated that in Hazára the people were not allowed to burn even pure grazing grounds where there were no trees; he would make over to the villagers a sufficient area for grazing, which they might burn, but he would make them responsible that these fires did not extend to forest reserves. *Captain VanSomeren* wished to know what tree, adapted for planting in fire-lines, yielded at the same time a useful product.

Some of the members present suggested the *Pongamia glabra*, and *Dr. Schlich* thought that, where circumstances admitted of it, every encouragement should be given to cultivation on the cleared fire-lines, for a belt of fields all round a forest would certainly afford good protection. *Mr. Amery* said he had tried this plan in Goruckpur, but found it impracticable. *Mr. Greig* remarked that the moral support of the district officer was very necessary, and it was most important for the forest and civil officers to be on good terms.

Captain Bailey then explained his "ladder" system of cutting and burning fire-lines, which is described on page 52 of the first number of the "INDIAN FORESTER." The following paper by *Mr. A. T. Drysdale* was then read by *Mr. Prevost*:—

History of fire conservancy in the Mailghát.

The Mailghát, or the portion of the Satpúra range of hills included within the Hyderabad Assigned Districts, is estimated to cover an area of about 1,500 square miles, and may briefly be described as a series of rough basaltic hills, intersected by deep ravines, through which flow the several confluents of the Tapti. The hills vary in height from 1,500 to 4,000 feet above the level of the sea.

2. The forest contains a large variety of timber trees, of which the principal and most valuable are—

	Local name.	Botanical name.
1.	Teak ...	... *Tectona grandis.*
2.	Tewus .	... *Dalbergia Oojeinensis.*
3.	Sheshum ...	... *Dalbergia latifolia.*
4.	Sadra .	... *Pentaptera tomantosa.*
5.	Dowra ...	.. *Conocarpus latifolia.*
6.	Huldoo ..	... *Nauclea cordifolia.*
7.	Lendya ...	... *Lagerstroemia parviflora.*
8.	Behera	... *Terminalia bellerica.*
9.	Mowah ...	... *Bassia latifolia.*
10.	Mango . .	... *Mangifera indica.*
11.	Dhamin ...	... *Grewia latifolia.*
12.	Tendu ...	... *Diospyros Melanoxylon.*
13.	Sewan ...	... *Gmelina arborea.*
14.	Kalam ...	.. *Nauclea orientalis.*
15.	Chironjee ...	.. *Buchanania latifolia.*

3. To give an idea of the quality of the timber of the Mailghát I make the following extracts from a report by Major Pearson in 1864. Referring to one of the best teak-producing areas, Major Pearson writes: "I have no hesitation in saying that this is without exception, both as regards the growth of teak trees and the value of the timber, by far the best teak forest in the whole range of the Satpúra hills." And again, in describing one of the larger ravines, he writes: "The depth of this gigantic ravine is from 1,000 to 1,200 feet, the sides rising up in almost perfect precipices. Its breadth at the bottom varies from 200 to 500 or 600 yards; its length is said to be 10 miles, and I went along it myself for more than half that distance. I have never anywhere, except in the best sál forests, seen any trees to be compared to the immense sadra (*Terminalia tomentosa*), Huldoo (*Nauclea cordifolia*), Lendya (*Lagerstroemia parviflora*) and Behera (*Terminalia bellerica*), whose trunks run up to a height of 60 or 70 feet as pine trees and without a branch. Bamboo (*Bambusa arundinacea*) also largely exists, its graceful foliage adding immensely to the beauty of the ravine."

4. For purposes of forest management the Mailghát is divided into two descriptions of forest,—reserved and unreserved. The reserved forests occupy an area of about 400 square miles, the unreserved forests 1,100 square miles. Both descriptions of forest are under the direct management of the Forest Department. A map of the Mailghát shewing the subdivision of the forests is annexed.

5. In tracing the success which has attended fire conservancy in the Mailghát since its commencement in 1870 up to the present time, I shall describe, by extracts principally from the annual reports, the results of each year's experiments separately, and conclude with a few general remarks. The fire-paths that have annually been made, as well as the areas of forest

that have each year been protected and burnt, are shewn on the accompanying maps. On these maps the fire-paths are painted red, the burnt portions of forest black, and the unburnt portions have been left uncoloured.

A statement is also appended shewing the length and cost of fire-paths burnt, the area of forest protected, and such like interesting particulars for each year.

1870. 6. Previous to the year 1870 no attempt was made to prevent fires in the Mailghát. Till then the whole area of the forests had annually been burnt. In 1870 a block of the Byraghur reserve, having an area of about 30 square miles, and comprising the best-wooded portion of the reserve, was selected for special treatment. A fire-path, 16 miles in length and 60 feet broad, was cleared round it at an expenditure of Rs 1,860 or Rs. 116-4 per mile, and an establishment for patrolling purposes was entertained from 1st January to 15th June, costing in the aggregate Rs. 660.

The large expenditure incurred in clearing the path was owing to the inexperience of the establishment at work of this nature. Instead of the grass on the path merely being burnt, it was uprooted, and, moreover, all trees and underwood growing on the line were cut down. In fact the path was made more like a road for wheeled traffic than a temporary barrier against fire. The patrolling establishment was so distributed that daily reports were received of the state of the entire length of the path.

These measures proved successful and the whole area of the block was saved, the total cost amounting to Rs. 84 per square mile of forest protected.

1871. 7. In 1871 the same steps were taken for the protection of the Raipur block as in 1870, and are thus referred to in the annual report—

"A fire-path was cleared all round the block except where the river Seepna forms its limit and affords a natural defence. To prevent the possibility of fire reaching the block from outside all grass for some distance beyond the fire-path was burned at the commencement of the season (January), and nine watchers at Rs. 8 each per mensem engaged for patrolling purposes.

"The cost of these measures was—

Clearing 16 miles of fire-path	...	..	...	Rs.	175-12-0
Watching fire-path ...	...	...	...	„	472- 2-3
			Total cost ...	Rs.	647-14-3

or about Rs. 40-8 per running mile, or Rs. 21-10 per square mile of forest protected.

"The above comprise all means it is possible to take for fire protection, and, though generally they ought to suffice, yet the difficulty of the total exclusion of fire is very great, as a thoroughfare passes through the tract, and it is with the greatest difficulty the watchers succeed in preventing travellers lighting fires for cooking on their way through.

"In one portion, however, a fire did break out, though it was extinguished before any damage was done, having only burned a spot of open ground 600 yards long by 100 yards broad, and, as the fire had not entered from outside the reserve, it is supposed to have originated from the above cause within, unless purposely lighted by an incendiary, though no clue as to its origin could be satisfactorily discovered. No damage being done, however, the matter is hardly worth mentioning, except as an instance of the difficulty of preventing fires or tracing their origin.

"Undoubtedly the advantage, to young trees particularly, of the exclusion of fire can hardly be over-estimated. Instead of their being stunted and burnt down until they can make a sufficient shoot in one year to overtop the effects of the flame, they come up as seedlings and are permitted to make uninterruptedly the annual growth which nature intended; and one cannot fail to be struck by the numerous saplings found struggling through the long grass in the protected tract which the fire must inevitably have killed.

"Another result should not be forgotten. The long grass which covers the ground and feeds the jungle fires, on being preserved for a number of years, annually dies down and rots during the rains, enriching the ground by a thick layer of decayed vegetable matter, which is also supplemented by the defoliation of trees. Fire also, when unable to kill the large trees, scorches their bark, burns and kills the seeds they have shed, and often damages them to such an extent that they bear signs of the injury ever afterwards."

1872. 8. In addition to measures similar to those taken in previous years for the protection of the Raipur block, the road leading through the block, and in the vicinity of which a fire broke out in 1871, was cleared on both sides to a breadth of 60 feet. The cost of the above amounted to—

Burning fire-paths	...	...	...	Rs.	126-11-0
Pay of temporary watchers			...	„	275 6-8
			Total ...	Rs.	402-1-8

which is less by Rs. 245-12-7 than the expenditure in 1871.

No fires broke out during the year within the block, but the same success was not attained in preventing fires entering from without. On the 24th of March, the inhabitants of a small village, situated a short distance beyond the path, set fire to the grass below some mohwa trees to enable them to gather the fruit more readily, and took no proper precautions to prevent the fire spreading. When the watchers reached the spot, a high wind had sprung up, and their efforts to extinguish the flames were of no avail. Word was at once sent to Mr. Ballantyne, the Assistant located in the reserve, but by the time he reached the place the fire had leaped across the path, and before it could be got under about 7 square miles, or nearly one-fourth of the block, had been burned. Unfortunately this fire broke out during the Holi festival, when most of the men engaged in forest operations at Pili were on leave, and when the generality of the Koorkoos (the indigenous inhabitants of the Mailghát) had so entirely given themselves up to feasting as to be unfit for work of any kind.

The following extract from Mr. Ballantyne's report will convey some idea of the severity of the fire:—

"Every nala and hillside where the grass was thin was taken advantage of. Paths were cut as quickly as possible; but, as soon as they were made, the fire was seen again far ahead. There was a hurricane blowing all the time that carried up large firebrands of burning bamboos, &c., which were often transported to a distance

of 500 yards and dropped among the grass in front. This was what made the extinguishing such a difficult task."

A portion of two of the plantations was also burned, but the plants suffered very little damage, the grass not being of the same rank growth as in the regular forest. The plantations were guarded by a large nala, as well as by a path 60 feet broad; but these were useless against the flames, backed up, as they were, by so strong a wind. As soon as the fire was got under, the breadth of the paths was increased to 300 yards, it being considered that nothing less than this could be relied on for the exclusion of outside fires.

An attempt was made this year for the first time to keep down fires as much as possible within the remainder of the Byraghur reserve, and the results are exhibited in the subjoined statement. Hitherto the whole of the area had invariably been burned.

	Inhabited villages.	Uninhabited villages.
Unburned	31	21
Partly burned	27	10
Entirely burned	36	36
Total .	94	81

Thus, of 175 inhabited and uninhabited villages, 52 were entirely saved, 37 partly burned, and 86 wholly burned, or, estimating roughly, fires were kept out of half the reserve, or nearly 200 square miles.

Comparatively little difficulty was experienced in extinguishing fires that broke out within the reserve itself. The fires that caused most trouble were those which came from without (the Central Provinces), and which were often several miles broad. In 1871 the beneficial effects of the exclusion of fires within the Raipur block were noted. The effect on the grass itself has now become most marked. In many places grass has disappeared almost entirely, and its place has been taken up by seedlings and underwood, the surface of the ground being covered with a fine coating of vegetable mould from the annual decay of their leaves. In others the old grass, by excluding light and air, has prevented the production of new grass, but wherever grass exists it is of a much finer growth than formerly This I attribute to the old grass falling over at the end of the hot weather and retarding the springing-up of a fresh crop. In walking along the fire-path the difference in the growth of the grass on the two sides is clearly discernible. Where fire has been excluded the grass is as small again as where fires have taken place annually.

1873

9. 1873 was the fourth year in which special steps were taken to exclude fire from the Raipur block. In the month of January a path 300 yards wide was burned round the forest, and this was entirely successful in preventing fires entering from without. Inside the block no fires occurred during the year. As usual, a temporary establishment of eight watchers, at Rs. 8 each per mensem, was entertained to patrol the path during the hot weather. The total expenditure incurred on the above measures amounted to Rs. 954-6-2. Thus:—

Burning fire-paths	Rs. 741-0-6
Pay of temporary watchers	„ 213-5-8
Total ...	Rs. 954-6-2

Towards the close of the cold weather, when the grass is comparatively green and does not burn readily, a path was cleared all round the reserve. This was done by the watchers themselves, assisted by a few coolies at a cost of only Rs. 46-13-0. The grass was lighted along the boundary line and extinguished on the reserve side, but allowed to burn unchecked in the opposite direction till it went out of itself from the heavy dews which fall at night during this period of the year.

The path proved an effectual stoppage to outside fires. Several fires, however, broke out inside the reserve, but they were speedily got under by the inhabitants, before any material damage was done.

Only two extensive fires occurred, and these were accidentally kindled, not by residents of the reserve, but by people from the plains. At the very least seven-eighths of the reserve or about 350 square miles were saved.

The following statement exhibits the number of villages in the jungles of which fires took place wholly destructive or partly so:—

	Inhabited villages.	Uninhabited villages.
Unburned ...	61	68
Partly burned ...	9	5
Entirely burned	4	8
	94	81

10. No fires broke out during 1874 in the Raipur block, and the expense of the measures adopted for effecting this was little more than half that incurred last year, although exactly the same measures were had recourse to. This great difference in expenditure was owing to the employment of a cooly corps, consisting of Gonds principally instead of Koorkoos, in the burning of fire-paths, &c.

1874

During this year also the entire reserve was for the first time protected from fire, the only expenditure incurred being in the grant of rewards to patels of villages to the extent of Rs. 180. A fire-path round the reserve was burnt as usual by the establishment in the cold weather. Every year that fire is kept out of the reserve the easier does the task become of extinguishing fires that may accidentally or of design break out in the future, for, with the exclusion of fires, the sides of ravines and hills become so thickly covered with seedlings and undergrowth that the grass is entirely eradicated. The effect is of course not so noticeable in more open localities.

Natural reproduction throughout the reserve has become very marked. Fine young trees are springing up in all directions. Such of them as were situated in open parts of the forest suffered rather severely last cold weather from frost, but those in sheltered localities and on the higher ground escaped entirely.

11. This is the sixth year that fire has been successfully kept out of the Raipur block. The same measures were taken for the protection of the tract as in former years, only instead of burning the fire-paths departmentally the work was done by contract for the sum of Rs. 250, or at the rate of about Rs. 10-6 per running mile. This is not high, considering that the grass on both sides of the path has to be cut to a breadth of between 10 to 20 feet before the intervening grass is burned.

1875.

The efforts of the department to keep down fires within the reserve were again attended with complete success. In addition to the fire-path, which is usually burned round the outer boundaries of the reserve, subdivisional paths were made during the year, so as to divide the reserve into 10 distinct blocks. Wherever possible, ravines, nalas and the like, which form as it were natural barriers against fire, were taken advantage of in the subdivision of the reserve. The paths, which are estimated to be altogether about 150 miles in length, were burned by degrees in the cold weather by the establishment. Only in very few instances was other labour required, as may be inferred from the smallness of the expenditure incurred, *viz.*, Rs. 72-5, or about annas 7-8 per mile. Notwithstanding all the precautions taken to protect the reserve, fire broke out in four different places during the year, but they were speedily extinguished, and little or no harm resulted from them. Of these four fires the origin of one only was traced, and this would probably not have been discovered but for the confession of the culprit. As year after year fires continue to be excluded from the reserve, the beneficial effects are becoming more and more apparent.

The grass on the better-wooded hillsides is gradually disappearing, and the surface of the soil becoming covered with leaves and other vegetable matter in various stages of decay. In the more open portions of the forest natural reproduction is making steady progress, and it is satisfactory to observe that teak increases almost as rapidly as other trees of less value. In the Raipur block in particular, one cannot help noticing the regularity with which blank spaces are being naturally planted up, and how well-proportioned teak is to other seedlings in such places. But what strikes the eye more than anything else is the comparative absence of charred trunks and the generally healthy appearance of the bark of the trees in the reserve, compared with those in portions of the unreserved forests annually devastated by fires.

The effects, however, of the exclusion of jungle fires are not confined solely to the vegetation of the reserve. Climatic and other changes are also taking place, of which the following are examples popularly recognised :—

(*a.*) The extreme heat of the hot weather is modified by increased moisture, diminished radiation and other effects of a dense and extensive undergrowth, whilst in open tracts during the cold season frosts are becoming common.

(*b.*) Water is now much more plentiful throughout the reserve than it was a few years ago. There is scarcely a nala of any size that does not contain a few pools of water in the hot weather, whereas formerly it was the exception to find water anywhere after February, except in the main streams.

(*c.*) In former years sudden floods used to occur regularly in the Seepna, Kapra, and Kandu rivers at the commencement of the rains. Since 1871 these floods have occurred later and with less severity year by year, which is attributed to the effect of the unburnt vegetation in retarding surface drainage.

(*d.*) There is less mortality at the commencement of the rains among the cattle in the reserve than in the unreserved forests. The cattle are, moreover, in better condition. This is attributed to the cattle not being able to gorge themselves with young green grass, as they do in burnt jungles. The green grass is always mixed to a certain extent with dry grass, and cannot be eaten singly till the dry grass has been beaten down by rain and overtopped by the green grass. By this time the green grass has sufficient strength in it to support the cattle without causing any injurious effects.

Other results, however, of not so satisfactory a nature seem to follow in the train of the above—

(*e.*) The climate of the reserve appears to be becoming more unhealthy every year. Fever and dysentery are prevalent at all seasons, but more particularly at the end of the rains and commencement of the cold weather. For instance, during the past year, out of our small forest establishment, numbering altogether 30 men, 1 jemadar

and 5 watchers died, another jemadar was forced to take sick leave and at the present time 4 watchers are so ill that little hopes are entertained of their recovery

(*f*) The plantations now suffer severely from the depredations of field rats, whose increase is no longer checked by annual fires

12 *General remarks*.—From the foregoing remarks it is apparent that fire-paths of themselves cannot be looked upon as a certain protection against the forests being burned Hardly a year has passed in which fires have not occurred in spite of all the precautions taken, and I am inclined to attribute the success of fire conservancy in the Mailghát more to the organisation and distribution of the establishment than to anything else, and this belief is borne out by the fact of about 200 square miles of forest having been saved in 1872 without any fire-paths whatever having been burned

In the Mailghát each watcher is placed in charge of a distinct block of forest, and over a certain number of watchers a jemadar is appointed Altogether there are 18 watchers and 3 jemadars, so that on an average each watcher has charge of 22 square miles, and each jemadar of 133 square miles of forest Then over the entire establishment there is a darogá

Moreover, a European officer, Mr Ballantyne, is present in the reserve during the whole of the working season, *i e*, from January to August of each year As a rule, the watchers cannot read and write, but the jemadars are required to send in weekly diaries to Mr Ballantyne describing the state of their charges and shewing the work done by them, as well as by each of their subordinates Nothing can happen in the reserve, therefore, without being immediately known to Mr Ballantyne Moreover, the very fact of a European officer being on the spot makes the establishment work much harder and pay considerable more attention to their duties than they otherwise would do

From the situation of Mr Ballantyne's head-quarters, which are on the highest plateau in the reserve and in a central position, no fire can break out without his observing it, and he is thus able to take steps to extinguish it, if such has not already been done by the watcher within whose charge it occurred Knowing that Mr Ballantyne is always present, the watchers seldom lose any time in proceeding to the spot when a fire does occur, and this is of very great importance, for a fire, when it first breaks out, can generally be extinguished with little difficulty, whilst, if owing to delay on the part of the watchers, it is allowed to gather strength and spread, it may burn for days before being put out

Then there is a great art in putting out fires It is no use trying to beat out a fire if the grass is long and there is a strong wind blowing, for no man could stand before it A counter-fire has to be made, and this requires great local knowledge, so that advantage may be taken of all natural barriers, such as roads, rivers, nalas, &c The counter-fire is made by firing the jungle from some road-side or nala bank in the direction of the jungle fire An expert watcher can fire the jungle at the rate of 4 or 5 miles an hour

He merely runs along the road or nala bank trailing a burning brand behind him, and if the grass is dry, it will ignite no matter how fast he runs

The road or nala will prevent the fire spreading in the direction from which it is lighted

It is sometimes possible to attack a jungle fire directly in front, as for instance, in places where the grass is short and there is little wind, or where the undergrowth is thick and the fire is burning down hill, but, as a rule, in the Mailghát jungle fires are extinguished by counter-fires

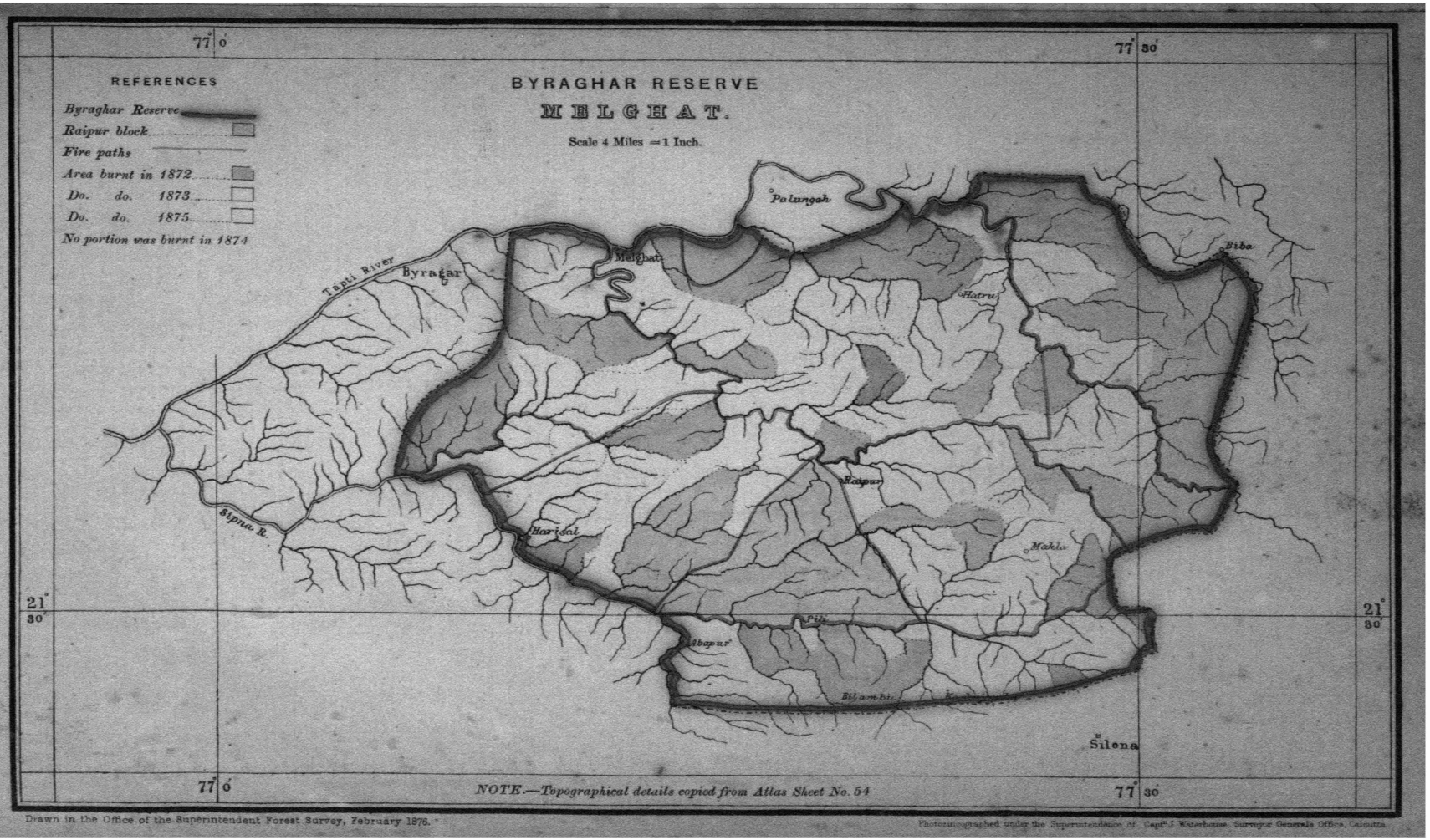
From the damage I have seen caused by fires in the Mailghát, and the marked improvements I have observed in the character and reproduction of forests from which fires have been successfully excluded for a series of years, I have come to the conclusion that the protection of forests from fire is the backbone of all forest conservancy in India Unless fires are kept down, little benefit can be derived from any steps taken for improving the condition of a forest, such as the formation of plantations, the encouragement of natural reproduction, thinning and pruning, &c

On the other hand, if fires are excluded, rest alone is sufficient for the reproduction of a forest, if it contains enough seed-bearing trees, and any additional measures that may be had recourse to to hasten the attainment of this object will be almost certain to meet with success if properly conducted.

APPENDIX A

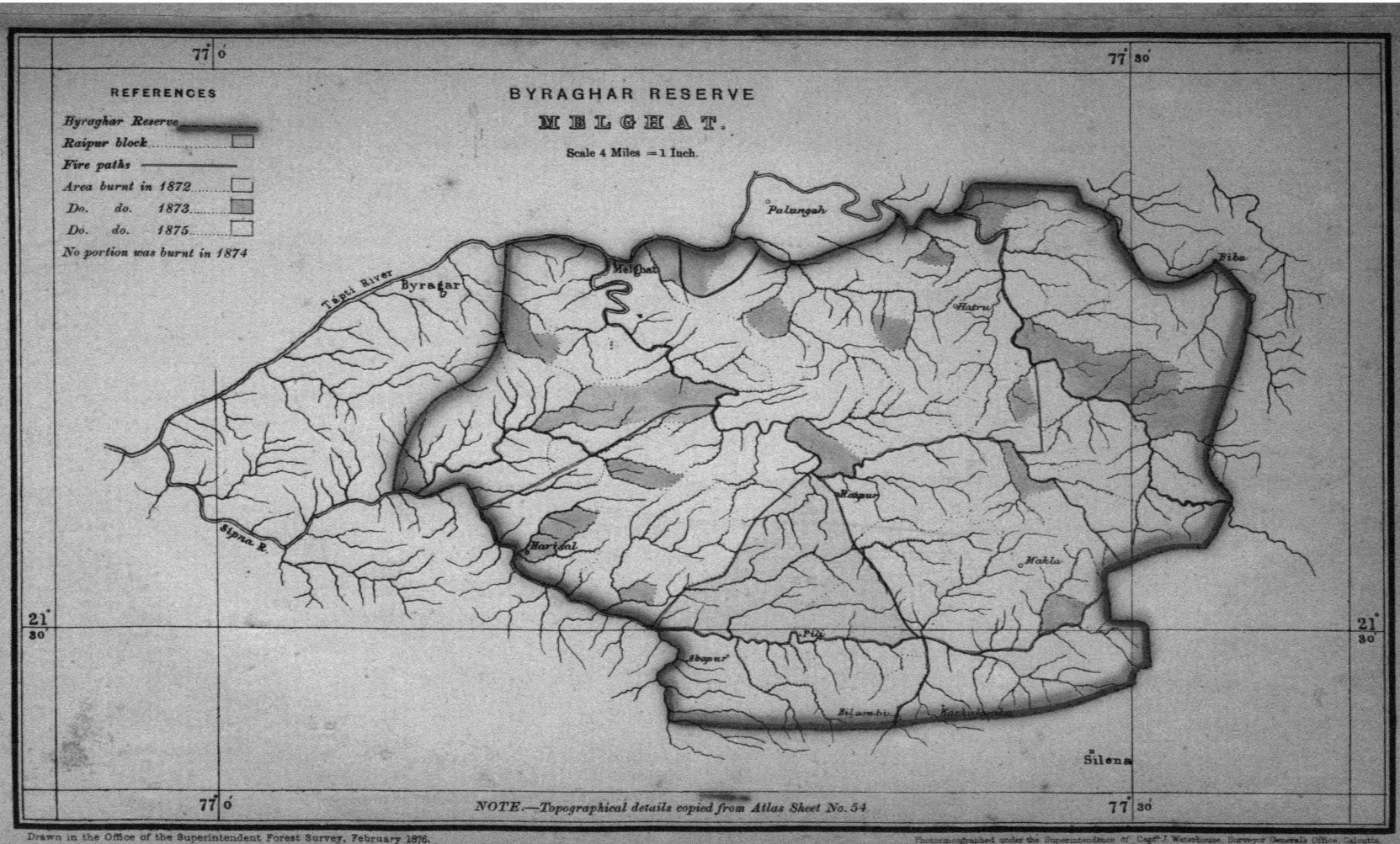
Year	Area of forest protected	Number of miles of fire path burnt	Cost of fire paths	Cost of fire paths per mile	Cost of fire path establishment	Total cost per square mile of forest protected	Remarks
	Sq Miles	Miles	Rs As P	Rs As P	Rs As P	Rs As P	
1870	80	16	1 860 0 0	116 4 0	660 0 0	84 0 0	
1871	80	16	175 12 0	10 7 9	472 3 3	21 9 5	
1872	230	24	126 11 0	5 4 0	275 6 8	1 11 11	
1873*	880	111	787 13 6	7 1 6	213 5 9	2 10 1	*During this year the officer in immediate charge of the reserve was sick and work was consequently not done so cheaply as it would probably otherwise have been
1874	400	111	880 0 0	8 6 8	116 5 9	1 11 10	
1875	400	174	822 5 0	1 13 7	275 8 8	1 7 10	

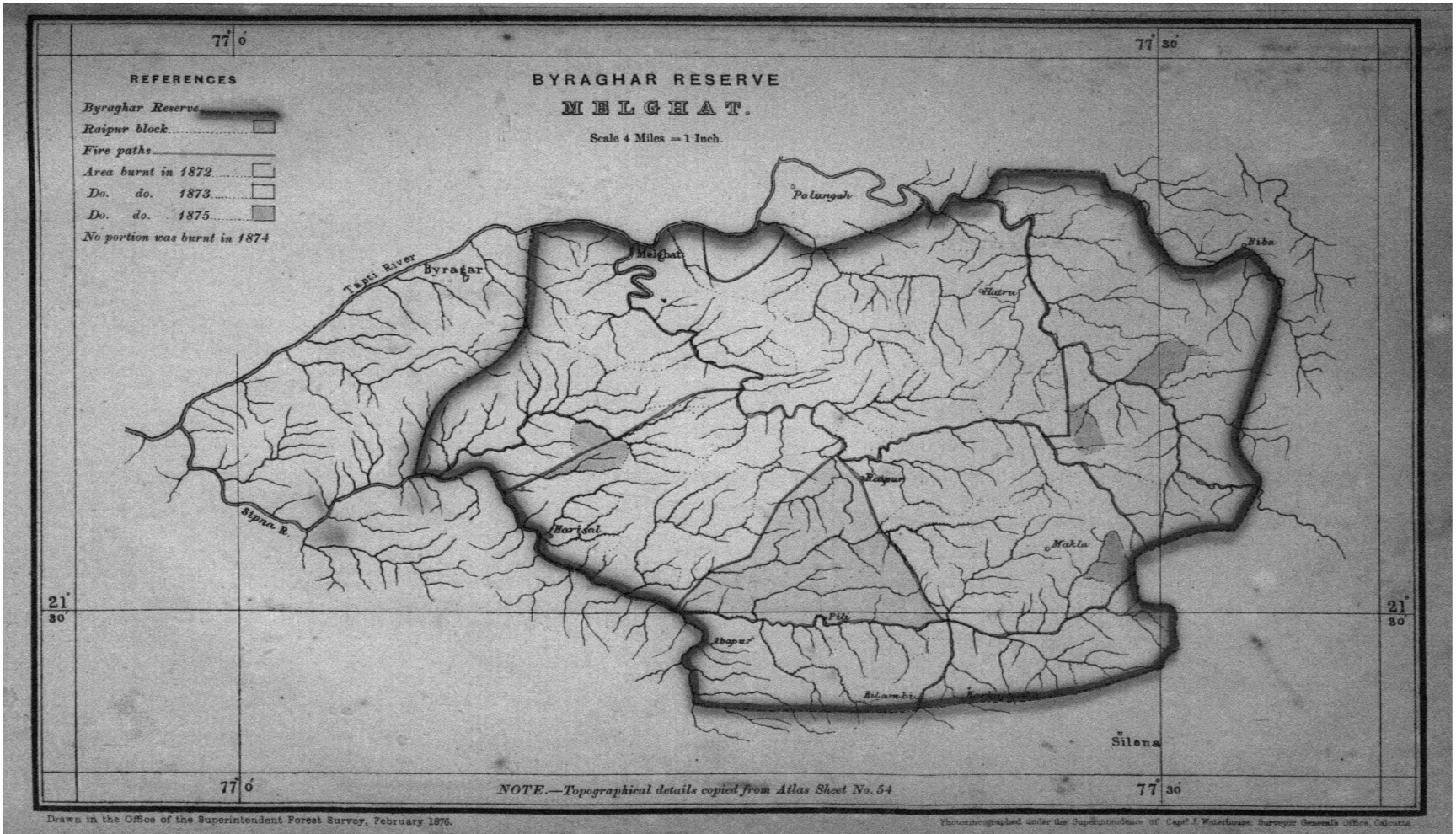
Mr Brandis then asked for information on the cause and origin of forest fires with special reference to two points, 1*st*, can the mohwa flower be



Drawn in the Office of the Superintendent Forest Survey, February 1876.

Photozincographed under the Superintendence of Capt.n J. Waterhouse, Surveyor General's Office, Calcutta.


77° 0'
77° 30'
REFERENCES
Byraghar Reserve
Raipur block
Fire paths
Area burnt in 1872
Do. do. 1873
Do. do. 1875
No portion was burnt in 1874
BYRAGHAR RESERVE
MELGHAT.
Scale 4 Miles = 1 Inch.
Palangah
Melghat
Tapti River
Byragar
Hatru
Piba
Sipna R.
Harisal
Raipur
Makla
Pitz
Ibapur
Bilamba
Kachi Amba
Silona
21° 30'
NOTE.—Topographical details copied from Atlas Sheet No. 54
77° 0'
77° 30'
Drawn in the Office of the Superintendent Forest Survey, February 1876.
Photozincographed under the Superintendence of Capt.ⁿ J. Waterhouse, Surveyor Generals Office, Calcutta.



Drawn in the Office of the Superintendent Forest Survey, February 1876.

Photozincographed under the Superintendence of Capt. J. Waterhouse, Surveyor General's Office, Calcutta.

collected without setting fire to the grass? and 2*ndly*, is it under all circumstances necessary to burn the grass in order to produce good pasture? *Mr. Wroughton* thought it was not possible to gather mohwa on the Khandesh hills without burning the grass; but *Mr. Dunbar* said that in the Panch Mahals it was quite possible to pick up the mohwa from under the trees, which were generally pretty close together and on level country, without burning, though burning did make the process easier. *Mr. Gibson* was of the same opinion, and said that grass was too valuable in the Tánna district to be wilfully burnt, and hence mohwa, was collected without burning, even on hilly ground.

From the Central Provinces the testimony was unanimous that there was no difficulty in collecting mohwa, even when grass was not burnt. *Mr. Amery* said that in the North-West Provinces people preferred to burn the grass, and *Mr. Johnstone* stated that in Bengal the grass was not burnt, even on undulating ground. *Mr. Horsley* remarked that in Khandesh men sit up all night to prevent sambar and bear from eating the mohwa, and they clear away the grass and rubbish, but do not burn it.

With regard to the second point above mentioned—the interest of the graziers—*Mr. Duff* said that at certain elevations it is necessary to burn the grass, otherwise good fodder will not be found. At higher elevations the snow effects what fires do below. In Kullu a permit is given every year to the villagers to burn certain spots. If fire extends beyond these defined areas, the villagers are punished by the stoppage of their grazing, or in case of malicious mischief by a fine. There are, however, certain parts of the hills where grass grows sufficiently well without firing, and others where leaf fodder is plentiful.

He also stated that in certain localities grass not burnt was fit for nothing but thatch after the third year. *Major Waterfield* said that the same was true of Hazara, where, if the old grass is not burnt, the cattle cannot get at the young shoots. Again, on the hillsides there are places where the needles of coniferous trees lie thickly and render the ground so slippery that cattle find it almost impossible to retain their footing; here also firing is necessary. *Mr. Brandis* remarked that burning exposes the soil to the action of the rain, and much more soil is washed from a burnt hillside than from one that remains unburnt. *Major Waterfield* stated that, after the burning in Hazara, a sufficient time elapsed before the rains set in, to allow the young grass to spring up and prevent the soil from being washed away. *Mr. Brandis* agreed generally with Mr. Duff that in the hills there were parts where firing was a necessity in order to obtain good grazing, and then asked whether it was under all circumstances necessary to burn the grass in the plains.

Captain Wood replied that green shoots do exist among the old grass, but are not easily found by the cattle. *Mr. Oliphant* said that firing had the effect of making the young grass spring up one or two months earlier than it otherwise would do. *Captain VanSomeren* said that he could sell the grazing in the Devaroydroog forest, which had been preserved from fire for the last nine years. *Messrs. Mann* and *Amery* agreed with Mr. Oliphant that from the grazier's point of view it is advantageous to fire the grass *Mr. Duff* said that the people themselves were the best judges, and where it was possible to give permission to burn without risk to our reserves we should do so. *Captain Wood* remarked that in Oudh he was not entirely against burning, and that he regularly fired all the open glades (*phantas*) but wished to preserve the sál forest. *Mr. Brandis*, in closing the discussion, said that outside our reserves we had no interest in wishing the people not to burn their grass except in so far as fires outside endanger the reserves; but that inside our reserves we must strenuously endeavour to keep out fires at all hazards and by every possible means.

Forest Rights and Privileges.

Mr. Horsley then read a paper in connection with this subject as follows:—

The Khandesh Satpúra Forests and their Bheel inhabitants.

The object of this paper is to describe what is, I believe, a typical instance of a class of questions which must necessarily be properly settled in every district before forest administration can be successfully begun—the question, namely, of the prescriptive rights of jungle tribes

and the way to manage them. A good deal was said this morning about the difficulty of getting evidence about civil actions and mischief under the penal code, but the Forest Department ought and can have its rewards and penalties quite distinct from the penal code, and can rule the jungle men without reference to a magistrate in most cases, if only an attempt is made to understand the people thoroughly.

The country treated of in this paper is an interesting one, being that part of the great Satpúra range which bounds the province of Khandesh to the north and forms part of the watershed of the two largest rivers of Western India, namely, the Tapti and the Narbada.

The people whose prescriptive rights are here alluded to are also an interesting race, widely known both in the Central Provinces and in Western India, and nowhere more at home than in Khandesh, and they are the Bheels.

For a distance of nearly 200 miles from a point a few miles west of the well-known fortress of Asserghur to the boundary of the native state of Rajpeepla, the northern boundary of the province of Khandesh runs in an irregular line through the hill country of the Satpúras. In one tract known as the Pal Tappa, the boundary has been laid down so as to include nearly the whole breadth of the range. In the adjoining tract, known as the Dhowle Baree, the boundary runs along the centre ridge or backbone of the Satpúras, and again further west in the Akrain pargana, the Khandesh boundary includes the entire range and runs along the southern bank of the Narbadá.

This large hill tract, nearly 200 miles long, with a breadth varying from 10 to 50 miles, contains several distinct kinds of forest and presents at different points entirely distinct problems for the forest officer and his coadjutor, the forest demarcation officer. A description of three of these distinct tracts will, perhaps, put the case more plainly.

The Pal Tappa or hill division of taluka Sonda is approximately 390 square miles in area. It is bounded on the north and east by Holkar's territory and the province of Nimar, the boundaries being defined by a line of masonry pillars, on the west by the Chopra hill district, and on the south by the plain of the Tapti. Within this area there formerly existed over 70 inhabited villages, which were, according to tradition, nearly simultaneously destroyed by a former Maharaja of Indore. The sites of many of these villages and in some instances remains of houses, wells, &c., are still visible; but perhaps the most common and most interesting remains are the huge stone sugar and oil mills which lie scattered all about this vast jungle and tell their silent tale of the cultivation which once existed.

The appearance of a great part of the jungle quite confirms the tradition of simultaneous and wide-spread destruction. Such trees as there are on many of the extensive plains of the Pal Tappa seem to be all of one age, including those which have grown up in the midst of the deserted houses and forts. Unlike other parts of the Khandesh Satpúras the Pal Tappa is not traversible by carts, except between Pal and Rarer, and some parts are difficult of access, even with baggage animals. As a forest the greater part of the Pal Tappa is not of much value. Besides the inaccessibility already mentioned the sparsely-scattered timber is mostly worthless. All over the eastern and northern parts the jungle consists almost entirely of salai (*Boswellia thurifera*) which, as far as is at present known, is only useful as firewood. A little Anjan (*Hardwickia binata*) is scattered about with other of the commoner jungle woods. A few stunted teak and khair trees are to be seen; but in the course of many days' walking in this part of the Pal Tappa, I do not remember to have seen a single fine teak tree or any really promising coppices. The soil is mostly rocky and poor, and nothing but salai and anjan appear to flourish. There is not much chance of this jungle ever yielding any considerable forest revenue. The timber growing on it is not of a kind to tempt thieves. The anjan is protected by the Khandesh rules, and very little else which grows here would pay the cost of carriage down to the plain. Under these circumstances, there is very little reason to fear the de-arborisation of this tract. Even if cultivation is allowed to extend in various directions over it, the denudation would be trifling; the colonists would clear away a few hundred acres round their village, but there would be no temptation to fell a single extra tree. The greater part of this rocky maze of hills and valleys must necessarily remain for an indefinite period *in statu quo*, for forest revenue from it is of little value; but there are many parts of it, formerly highly cultivated and now covered for many months of the year with grass four or five feet high, which might well be re-colonised. Here then is a vast desert tract, at present only the home of the bison and the bear, rarely visited by men except when the Banjaras wander across it with their cattle, or a stray Bheel or Bahal goes searching for honey and moss, the wild *ál*, or some other jungle product for which he can find a sale. No inamdar claims rights over any portion of it, and the number of Bheels who make a living out of it is very small. It might nearly all be included as a forest reserve, but it would be better utilised by being partly re-colonised, and it so happens that the adjoining plain of the Tapti is getting overcrowded, and it seems probable that ere long a tide of emigration will set into the Pal Tappa. For these reasons only part of the tract has this year been selected as a forest reserve.

The next tract of the Khandesh-Satpuras known as the Dhowlee Baree or Chopra hill district differs very much in appearance from the Pal Tappa. It is intersected from east to west by the river Anner, on either side of which there is a large and tolerably fertile plain. The only three villages which for many years have existed in this large forest tract of about 12,800 acres lie at short distances apart on the bank of the Anner river. The rest of the tract has never apparently been cultivated. It consists of a constant succession of long ridges of hill with narrow valleys between them rising in height till the centre ridge of the entire range is reached. Along this, roughly speaking, runs the boundary of Holkar's dominions. As a forest, it is much more valuable than the Pal Tappa, being densely wooded in many parts, and contain-

ing a good deal of promising teak. Although the number of villages in this district is so small, still there is a considerable population of Bheels who make a livelihood out of it by wood-cutting, mohwa-gathering and collecting other jungle products. In considering the subject of reserving this jungle, provision must be made for these people.

The Akrain parganna, the third of these divisions of the Satpuras selected as typical, differs entirely in the existing conditions from either of the other two. With much the same natural features, it is much more fully occupied. From 60 to 70 small villages lie scattered about it; various Mowass chiefs claim parts of the jungle and complicate the subject of forest demarcation with questions of the extent of their *huqs* and privileges.

There are thus three different classes of forests in the Satpúras; the first, a vast waste all available for reservation, but not all worth it; and the second and third much more valuable as a forest, but encumbered in different degrees with prescriptive rights and privileges.

To understand the nature of these rights, we must turn from the country to the people who inhabit it. This is not the place for a history of the interesting aboriginal race known as Bheels, and famous all over Western India for their skill in tracking wild animals and other woodcraft, but a slight sketch of their more modern history will not be out of place. Not so many years ago, within the memory in fact of an officer still serving in Khandesh, the Bheels living in the Satpúra tract already described were in a chronic state of rebellion. From time to time, under the leadership of various *naiks* or chiefs, they descended on to the fertile plain of the Tapti, looted villages there, and carried the spoils back to their fastnesses in the Satpúras. It was repeatedly necessary to send troops after them, and to keep up a guerilla warfare with them for months together. All this time the Satpúras were their property and their home. How this state of things was altered by the pluck and tact of Outram and his successors is a matter of history, and the Khandesh officer of to-day sees with wonder the complete transformation which the wise and gentle measures adopted have effected. Now the European officer can wander all over this wild tract, not only unmolested, but even welcomed by each small colony of Bheels whom he may meet. Every hill and valley in the range are being mapped by the trigonometrical survey, with Bheels for their guides. The Bheels have, in fact, become a thoroughly inoffensive population, or at least they are not likely to offend any one except the Forest Department.

In their relations with the Forest Department, especially where their colonies lie thickest, there is no doubt a difficulty, and one which calls for settlement without delay. A wandering wood-cutting population is a very wasteful one, doing an amount of damage disproportionate to the actual cost of their livelihood.

The policy of Government towards them has been for many years to get them to take up less room, so to speak. If they would only take to agriculture, combined, say, with lac cultivation and cattle-breeding, 200 acres would go as far as 2,000, or even more, do now.

Efforts are being annually made to bring about this desirable result; bullocks are bought by Government, branded with Government mark, and lent to them to plough their land with, and being Government property the sowcar cannot touch these. Seed is bought and given to them on condition of repayment. All such measures, however, take time to bear their fruit, and the Bheel still clings to his wood-cutting, preferring to do one day's hard work in the week and live on the proceeds for the next six.

Meantime, too, the Forest Department wants its claims settled and defined. If it were to be a case of antagonism—Forests *versus* Bheels—and if that only half-tamed population were to get the impression that they are to be roughly treated, much of the good done during the past 30 years would be lost. The case is eminently one for a compromise. Vague claims become less formidable when they are enquired into. The position at present is as follows. The Satpúra forests are the great source of wood supply to the plain of Khandesh. The Bheels living in those forests have a right to make a livelihood by supplying some of that wood. At present Government reserves to itself nine kinds of timber; all other kinds of wood may be cut and carried out of these forests by any one on payment of a small fee. Thus, a sowcar, living in the plains of Khandesh, miles away from the Satpúras, can send up a dozen carts with his servants and cut and carry off the wood he wants without consulting or employing the Bheels or paying them anything.

It is true that the Bheels can also cut the same wood and carry it down to the markets for sale, but they are mostly too poor to own carts, and can only carry down one small log at a time on their heads. What irritates them is to think that a man living far away and having no conceivable claim on the forests, can carry off the wood from round their village without their being able to make anything by it, besides their being ousted in the local markets by the competition of men who command capital in the shape of carts, bullocks, &c.

The remedy appears to be to give the Bheels a practical monopoly in this jungle wood. Government can retain its established right to the nine most valuable species of timber all over the Satpúras. It can go further and close certain large uninhabited tracts to the axe altogether; but outside these imperial reserves, and in the parts wherever Bheels live, they, who alone have a claim on the jungle, should be allowed a monopoly of the jungle wood. They live and have always lived in the jungle; they incur constant risks from wild animals. They held these jungles as their absolute property not many years ago, and now, pending their hoped-for transformation into settled agriculturists, they have a distinct claim to some special rights. As it happens, the monopoly can be granted to them and can be made to work so as to give them a livelihood without loss to Government, or the possibility of valid objection from any class of its subjects.

The details of the system now proposed are as follows, *viz* :—

1*st*.—That the Satpura district be divided taluka by taluka into two portions, one a first class reserve in which no cutting of any sort be permitted, and the other a second class reserve, in which only nine sorts of trees be reserved.

2*nd*.—That a list be made, taluka by taluka, of all Bheels who at present make a livelihood by cutting and selling unreserved timber and bamboos. That these persons be registered, and each man supplied with a wooden ticket, having engraved on it a serial number and the name of the taluka, empowering him to cut unreserved wood and bamboos in the second class portion of the forest and carry it free of charge to a specified market. Each such ticket being intended only to allow of as much cutting and carrying as each man can manage by his own personal exertions. Thus, in a family consisting of several persons, each adult male would have his own ticket, but no one is to be allowed to suppose that by virtue of his ticket he can become a kind of wood contractor for sowcars of the plains by merely accompanying their carts to the *naka* and shewing his ticket.

3*rd*.—That only holders of such tickets be allowed to cut unreserved timber and bamboos in the 2nd class reserve on these terms. That these tickets be issued by the demarcating officer as the result of personal inquiry, and on the recommendation of the principal Bheel agent and the Assistant Collector in charge of the taluka, the issuing of these tickets being a matter of considerable importance, being in fact a registering of hereditary Bheel rights. Each ticket-holder to wear his ticket whenever employed in wood-cutting, and to shew it whenever called on to do so.

4*th*.—That, for the convenience of the rest of the inhabitants of the plain of Khandesh, a notice be posted at every town or village where a weekly bazaar is held, shewing the price of different kinds of wood, and stating how they can be obtained through the Forest Department.

Thus, the ticket-holders would have a monopoly of the supply of unreserved timber, and the general public, wanting any wood which the ticket-holders cannot supply, could get it through the Forest Department by the agency of a depôt or otherwise. The ticket-holders, who of course would be Bheels and other jungle men, would thus be enlisted on the side of forest conservancy. It would become their interest to keep out interlopers by reporting any unauthorised cutting Their retention of their tickets might be made conditional on their giving such aid to the Forest Department. The value of their monopoly would be sufficient to make the loss of their tickets a severe punishment. The department would thus get a large force of unpaid foresters. Meanwhile, too, a large portion of the best Satpúra forest (the first class reserves) would enjoy a complete rest from all cutting which they much need, and would in time grow really valuable timber. The second class reserves in which the ticket-holders are to have the monopoly of cutting unreserved timber must of course be large enough to constitute a practically inexhaustible supply, or at any rate enough to last till such time as the Bheels can be induced to take to agriculture. The second class reserve must also be so chosen as to include all the Bheel villages, the uninhabited parts being marked off as first class reserves.

Some further detail would, of course, have to be arranged; but the general principle is this: the Bheels have an undoubted claim to make a livelihood out of the Satpura forests. We propose to concede this formally to them in such a way as to enlist them on the side of forest conservancy. We give them the monopoly of the unreserved wood in part of the forests on condition of their helping us to preserve the nine sorts of reserved timber all over the Satpúras, and all kinds of timber in our first class reserves. At present they do not feel sure that Government really recognises their claim. When they each get their wooden ticket and know that they are registered and formally recognised, they will value the right and be useful aids to the Forest Department.

I have thus endeavoured to depict one of the present forest problems of our Presidency, together with the proposed solution. Every forest officer whose duty leads him into wild and thinly inhabited districts, cannot but feel the importance of enlisting the jungle tribes in his favour, and making them feel that the Government, which wishes to preserve the jungle, knows that it cannot do so without the cordial co-operation of the jungle tribes.

Mr. Brandis, in thanking Mr. Horsley for his excellent paper, remarked that much has been talked and written about the antagonism of district and forest officers; in his opinion it only existed in imagination. Civil and forest officers have one duty and one object, *viz*., the welfare of the people. The Forest Department has no more powerful auxiliary than the wild tribes of the Indian hills, and the proof of a good forest officer is, that he feels sympathy with these people, and endeavours to make them trust him and like him.

(All jungle tribes have certain rights which must be respected, though they are undefined, and in many cases it is out of the question to come to a clear legal understanding with regard to these rights.) The area of our reserves is limited, and if they are formed with judgment, our object will be attained. Mr. Horsley has told us that no difficulty is experienced in Khandesh in forming certain tracts into reserves, and in reserving certain kinds of trees in others, and that this can be effected without curtailing the profits and privileges of the Bheels. *Captain VanSomeren* agreed with Mr. Horsley that "vague claims become much less formidable when gone into;" this was decidedly the case in

Mysore. *Mr. Wallinger* inquired whether there was to be no supervision over the cutting by the Bheels. After they have eaten their cake what is to be done for them? *Mr. Horsley* replied that they would gradually leave off wood-cutting and take to cultivation. *Mr. Amery* thought that the Bheels should be made to pay a nominal tax on forest produce. *Mr. Brandis* said that where rights existed the produce was not ours to dispose of. *Mr. Fernandez* said that those Gonds and other wild tribes of the Central Provinces, who were settled agriculturists, had no monopoly, and suggested that a similar system might be applied to Khandesh.

Mr. Brandis closed the first day's meeting with an expression of sympathy for the jungle tribes, and said we must place our reserves in such a position that they may be a source of wealth and not a hardship to the people.

The second day's proceedings began with Mr. Amery's paor on Forest Rights as follows :— Thursday, October 7th.

The subject of forest rights to which I have now to ask your attention is one on which I wrote a paper which was read at the last Forest Conference.

In that paper I confined myself mainly to laying down the distinction between *rights* and *privileges*, accepting these terms as expressing generally those concessions of lawful authority, which in the one case cannot and in the other may be withdrawn without the consent of the parties enjoying them.

But every *privilege* enjoyed under lawful authority is exercised of *right*, and, as in debate, sense is very apt to be sacrificed to sound, I propose that we dismiss the term *privileges* from the discussion and consider forest rights as alienable or inalienable.

Now, in the earliest stages of society the land is the common property of all. Every one has an equal right with every other to the whole, but no one has an absolute right to any part. There is no private property. As society advances, each man acquires an absolute right to a part by foregoing his general right to the lands held by his neighbours. This is the way in which private property originated. The lands remaining over after each man has secured his own allotment are public lands, and continue common property in which every one has a right to hunt and to help himself to forest products.

It very rarely happens in civilised countries in this age that we find lands in the possession of the first settlers; but in the very interesting paper on the Bheels of the Satpúra range communicated yesterday by Mr. Horsley, we have an instance of very early, if not aboriginal, settlers exercising until very lately common rights of property in a portion of the very territory roamed over by their earliest ancestors. Until their conquest by the British they afforded an instance of a people having common rights to the whole region they were settled in. The right of conquest is the strongest of all rights,—it is a right against which there is no appeal,—but I am very sure from the sentiments I heard expressed in this room yesterday that the British, who have now acquired a right to that territory, will not be opposed by the officers of the Forest Department in administering the land for the benefit of its ancient occupants, and they would be unworthy their present proud position in India if they did not administer the affairs of the region in such a manner as to elevate these interesting people in the social scale to an extent which will amply compensate them for the loss of independence, but, like the rest of the people of this vast empire, they must contribute their quota, however small, towards the costs of good Government.

As the case of these Bheels, although not without a parallel in India, is rather an exceptional one, I will just make a few remarks on the subject before proceeding with the consideration of the status of ordinary existing forest rights.

In all the civilised districts of India the British, on first assuming possession, proceeded to confirm the people in all existing rights, and to register such rights in deeds of settlements, reserving as public lands only such area as was not needed for cultivation, but the same action cannot be applied without modification to a people who are not cultivators. Without knowing the actual demand for timber and forest produce in this region, I can hardly think it expedient to convert the whole into forest, at least not if there is any hope that the Bheels can be induced to become agriculturists, and under any circumstances I am prepared to go a little further than this meeting did yesterday and to advocate that the State having appropriated such a forest reserve as local conditions may render desirable, the remainder of the land shall be settled on the people in tribal grants or village grants as may best consist with the prejudices of the people, and I would give them untrammelled rights in the products of such lands whether they choose to extract them as timber or cereals. There should be a fixed period of settlement, as in other districts, strict definition of area, but in some form or other I would make them pay this quota towards the expenses of their Government, it may be by assessment upon area, or, as they are not numerous, by a poll-tax.

It may, perhaps, be for the interests of these people and the people of the adjoining plains, that the Bheels remain foresters, living on the products of their forests, and if the officers of the Forest Department would give them kindly counsel on the subject of forest treatment, I confidently believe that these people, born foresters and taking to cultivation only from necessity, might in time render a Government Forest Department in their region quite unnecessary, and that they would become so prosperous that in future settlements they

would cheerfully submit to such an enhancement of revenue as would amply compensate the Government for the abandonment of its forest, and as civilisation spreads its meshes round them, creating the sense of new wants, they might take service in the Government forests of other regions, and prove a very high type of forest subordinate.

Nevertheless at the outset I think it would be desirable to maintain a considerable reserved forest area, that, in the event of the people proving improvident, we may be able to give them employment until their denuded areas shall have recovered themselves, or the people shall have taken to cultivate them. But I would have no sentimentality in treating them; settle nineteen-twentieths of the area upon them if you will, but not a stick from the reserved twentieth without payment. Treat them with justice and they will learn to help themselves; treat them with sentimentality and they will always look to the Government for help.

Adverting now to the general question, I observed that on the creation of private property in land such area as remained over continued the common property of all, as the whole area had originally been; but in a country of any extent it is very soon found that all cannot equally avail themselves of their common rights in the wastes, and, as soon as a large majority find themselves excluded by distance or other causes from enjoying their fair share, the administration of the wastes is vested in the head of the commonwealth or Government for the general good.

The State is not a private proprietor; a king may be, and is, in respect of all royal forests; but State forests are the property of the people at large, to be administered by their representatives for the benefit of all.

But the law can modify the status of public and private rights in land, and this brings me to the subject of prescriptive rights, a subject which I constantly hear discussed with as much fluency as if the law of property and the statute of limitations formed the ordinary light reading of every one of us. For myself I am free to confess that I have never had an opportunity of studying them, and yet I venture to express a very strong conviction that the popular notions on this subject, in and out of the department, as embodied in the two propositions, *firstly*, "that private individuals or special communities can acquire rights by prescription in public lands," and, *secondly*, "that the public can acquire rights by prescription in public lands," are utterly opposed to the law.

The first proposition I hold to be contrary to the spirit of English institutions, the whole tendency of which, as far as my experience goes, is to prevent the encroachment of private individuals on public rights. The public can acquire prescriptive rights in private property by proving undisputed exercise for a period of years,—I believe twenty under the English law,—because the law assumes that undisturbed exercise for as long a period as it is easy to collect evidence is itself constructive evidence of an ancient right, but in the case of a right of way thus acquired through private property the twenty or five hundred individuals who prove that they have exercised the right unquestioned for the prescribed period do not acquire a monopoly of such right for themselves alone, but for the general public; and if, as I suppose, the same principle is extended to the acquisition of all prescriptive rights, no individual or village community can acquire a monopoly of prescriptive rights in State forests under the law, because that in the exercise of such rights they represent the general public, and if a right could be acquired by prescription it would be the general public who would acquire it; an individual may acquire an absolute right in State property under the statute of limitation, but not a monopoly of a common right, leaving the State the owner of the land. If a public road, for example, were to fall into desuetude and an individual were to enclose, cultivate and maintain undisputed possession of it for twenty years, he would acquire a right of property in it under the statute; but if one man only exercised a right of way through it for twenty years it would not give him a monopoly of right of way. This is a public right and the individual represents the public in respect of the exercise of such right.

The second proposition, that the public can acquire rights by prescription in public lands, appears to me simply paradoxical. They cannot acquire partial rights in what is wholly theirs. An action to maintain such rights must be brought by the people's representatives. It would be a case of Regina *versus* Regina.

We hear a great deal about the rights of *the people*, but, as a matter of fact, the State, since it assumed the administration of our forests, never has admitted the existence of any class of public rights in them. To do so would be to cease to administer them.

With the one exception of the Sunderbuns, I believe there is not a forest in any province under the Government of India in which the public at large may cut a stick without sanction.

Such undefined rights as we do tolerate the exercise of are all of the nature of individual or village monopolies, and as these rights are upheld on the supposition that the law renders them inalienable, and as their exercise threatens the extinction of the forests, in some provinces at least, I venture to suggest that the legal points I have just raised be submitted for competent legal opinion that we may know whether the department's capacity for usefulness is fettered by real or imaginary bands.

Let us now pass from the abstract to the concrete. Let us take the several classes of rights now in exercise, and, testing them by the general principles I have enunciated, determine whether they are immediately alienable or temporarily or permanently inalienable.

It will be a great point gained to fix the status of every class of rights accurately, and this is the proper departmental share of the task. The method in which the rights shall be dealt with after their status is fixed will often be guided by considerations of expediency and is rather a question of State policy than of departmental action. There are many exceptional cases for which it is impossible to lay down general principles, and the legal rights of the State may sometimes be relaxed without injury to the public interest.

The first and simplest form of forest rights we have to contend with are such as were never formally conceded; they are the rights of fuel and grazing enjoyed by villagers in any forest or jungle near at hand. They may have been enjoyed for an indefinite period, but they have no legal status and are not hinted at in settlement records. They are, in fact, rights common to the people at large, but availed of only by the few who are near enough to the wastes to care to exercise such rights.

Now let us see how the Revenue Department dealt with them when the wastes were under their charge.

At the first great land settlement of Northern India the great anxiety was to get occupants for the land wherever there were waste lands adjoining villages. The zemindars were argued and coaxed into having them entered in their names, waste lands were often assessed as low as four annas an acre to induce neighbouring villagers to take them up. Since then the population of India has increased by nearly 20 millions, mainly agriculturists, and waste lands have been thrown open as fast, and faster than, the people wanted them. Forests, carrying timber which would now be worth a thousand rupees an acre standing, have been settled and the timber burnt on the ground for a revenue of less than a rupee an acre per annum, and from that period to this day the waste lands which have been settled and given in grants and annual leases in India amount to hundreds of thousands, if not to millions, of acres. In all these lands forest rights have existed from time immemorial, we are told; but, as acre after acre has been granted or settled, the rights have been annihilated. As the remaining wastes passed into the hands of the Forest Department, the rights exercised in some districts were enquired into, and being found to have no legal status were at once alienated, but in other districts the district officers in making over the forests to the new department intimated that certain villages enjoyed certain rights in the forest, and the exercise of such rights continue to worry us to this day. A village which pays an annual revenue of Rs. 20 an annum to the Revenue Department will sometimes utilise forest produce to the value of Rs. 200 per annum, for which we receive nothing; and this on the assumption that they have acquired rights by prescription. And yet to this day we are constantly transferring to the Revenue Department lands which they declare to be saddled with rights, but which they settle free of all rights, as soon as they get them, saddling the remaining forests with the whole burthen of them. If the Government has not absolute control of the wastes, every acre settled involves an illegal stretch of authority.

Next in order come the Kham tehsil rights, or the rights accorded to villagers who are annual tenants of the State within or near forest boundaries. These villages are all of recent origin. They are generally in remote districts, often in climates deadly during the rainy season, but in the anxiety to secure a land revenue in days when the forest as such would not yield it, unlimited forest privileges were offered as an inducement to settle even the smallest area. Here too a village will pay Rs. 20 of annual revenue and draw Rs. 500 of forest produce from the forest free of charge. All that they care for is the grazing ground for their cattle; the necessity of settling to secure these advantages they frequently regard as penalty. These rights are sometimes specified in the lease, sometimes enjoyed only on the *ipse dixit* of the district officer, and occasionally extend to the right to clear as much more forest as they like for cultivation.

The remedy is in the hands of the Government. The rights are alienable at a year's notice, when the leases may be renewed unsaddled with any rights beyond the right of cultivation within their prescribed village area. If the people do not value the village lands enough to continue in them and they hold land cheap because it is so easily obtainable, it is absurd to bribe them to remain by the gift of forest rights capable of being converted into ten times the revenue they pay.

The next class of rights is that in which the forest is parcelled out into village areas, in which, although the forest is held to belong to the State, the people have general rights of fuel and timber for home requirements and of grazing within their respective village areas. Our settlement of these villages is generally only a confirmation of the *status quo* under the old *régime*; the villagers cultivate but little land, and pay revenue only on the area under cultivation. The gradual reduction of forest area, keeping pace with spread of population, renders the continuance of this state of things highly impolitic; but the rights specified in the settlement records are inalienable during the period of settlement, but at its close the remedy is to assess the arable lands on the one hand, and the forest lands on the other at their respective market values, and 20 years hence I have no hesitation in saying that good forest land will yield a higher revenue in some provinces than arable land is now yielding. Meantime, the exercise of village rights must not be allowed to interfere with strict forest conservancy.

The next class of rights are those enjoyed under the permanent settlement of Bengal, and these are absolutely inalienable. In how far rights have been conceded in the Bengal forests, Dr. Schlich will be able to tell us better than I can, but as regards such rights as have been conceded under the permanent settlement they can only be alienated by purchase or commutation with the consent of the people enjoying them, but their exercise may not conflict with the exercise of the State rights, and it is the duty of the State to legislate for the protection of those interests in respect of which it owes a duty to the people at large.

Lastly come the Toungya rights. These rights constitute a distinct class of themselves and are practised under other names by so-called aboriginal races in many Indian provinces, and having been so practised from time immemorial, the Queen's proclamation to the people of India may be held to extend to the protection of the Toungya cultivators in their rights, but only so

long as their exercise shall be consistent with the general well-being The rapid spread of the settled population both of India and British Burma necessitates, and will continue to necessitate, the increasing annual conversion of forest into permanently-settled cultivation until all but the first-class reserved State forests shall have been taken up, and, unless special provision be made for the Toungya wanderers, they will by-and-bye find the available land for their labours so contracted that they must either settle permanently in one place or give way to thriftier races

I see no more advantageous course for the State and for these people themselves than to graft them systematically on to the Forest Department, by the complete working-out of the scheme already originated in British Burma, *viz*, the allotment of a given area of forest which they may work in rotation, conditional on their planting it with timber before clearing a fresh plot, the Forest Department having the right to any valuable timber before it is felled and burnt. In the course of a century or so they would convert the whole area operated on into first class forest which could be worked by rotation of area in the old manner, with the exception that the department would first remove all the timber, leaving only the branches to be burnt on the ground.

Meantime the Department would work its reserved area by selection, bringing these reserves also under Toungya treatment at the close of the period But these rights have no legal status; they are alienable, and what is more are being alienated with every fresh acre given to settled agriculturists. It will have been gathered from the foregoing remarks that I recommend the abrogation of all alienable forest rights on the ground that they are individual monopolies of State property whose holders contribute no quota to the State revenues in respect of such enjoyment, that I narrow down inalienable rights to those expressly specified in settlement records, that I advocate such proper restrictions to their enjoyment as is necessary for the due enjoyment of the rights which the State has reserved to itself, and their alienation at close of settlement whenever in the public interest it may be expedient.

I further advocate that it shall be left entirely to the discretion of the Forest Department to determine what forest area shall be thrown open to grazing, relying upon the good sense of the department not to restrict the area unnecessarily to the inconvenience of the people who are willing to pay grazing dues, and although in the case of the wandering herdsmen and shepherds who annually cross the Himalaya with their flocks and herds, grazing them *en route*, it may not be desirable to impose any tax at present They should be given to understand that they enjoy their rights solely at the discretion of the Forest Department, and that they may not be exercised in any block which may have been set aside for special treatment.

The vexatious point in connection with Indian forest rights at present is the common confusion of alienable and inalienable rights, and the occasional conversion of the former into the latter by the attempt to define rights which were supposed to exist already without definition, but which were undefined simply because they had no status There is also the annual cession of fresh rights to induce cultivators to clear and settle the forests

I will not detain you longer by dwelling on the desirability of alienating all alienable rights, and those temporarily inalienable as soon as they shall have become alienable. You will all have realised how impossible it is to maintain proper conservancy in the face of them. It rests with the Government to give existing alienable rights whatever status they please In my opinion they have no status now, but it would be as unjust to the public to allow forest produce in State forests to be removed free of revenue as it would be to exempt a whole district from the land revenue If rights are to be conceded, let it be on the principle recognised by all civilised nations that every right has its corresponding obligation, that no man can hold land or utilise its natural products without contributing his quota towards the costs of government in respect of such holding

The villagers of the Black Forest exercised forest rights before the time of Charlemagne, but these rights had no status until they were ceded by Imperial charter as one of the conditions of peace after much fighting, and we may very safely say that if Charlemagne could have foreseen the future importance of what he was conceding, there would have been a great deal of more hard fighting before he would have assented to the terms We have the matter in our hands with the experience of forest rights in Europe to guide us, and it will be our own fault if, disregarding the rapid spread of population in India, we allow the forests, which are of vital importance to the future well-being of the Empire, to be so heavily saddled with private rights, as will not merely render them valueless as a source of State revenue, but will necessitate the Government's buying them up at their then value in the interests of the general public. The Government dare not go back from the position that it has, *viz.*, absolute control of State lands. If it were to declare that it has only partial rights in them, it would render itself liable to actions for rights illegally alienated from all lands recently settled.

Dr. Schlich said that the bulk of the Government forests in Bengal are situated in the non-regulation districts. In the regulation districts there are hardly any Government forests except those in the Sunderbuns. All the Government forests in Bengal are free of prescriptive rights

Captain Wood remarked that certain lands in Oudh which had been made over to grantees free of rights have since been resumed by the Forest Department, and in consequence these tracts, in extent 120 square miles, are not burdened with rights, and he suggested that if we could give away all our forests in grants for a few years and then resume them, we should have our entire forest area freed from rights. After some further conversation between

Major Repton and *Captain Wood* on the land tenures in Oudh, *Mr. Gibson* remarked that in Tanna at the time of the settlement a large area of forest land was divided into numerous tracts or survey numbers and was made over to cultivators for their own use with the object that they would supply their wants in wood for fuel and other purposes from off these lands, also with *rab* or brushwood for burning on their fields. Subsequently proprietary rights over all the trees on these tracts, teak and blackwood excepted, were conceded to the cultivators. But the result has been far different from what was expected as soon as the cultivators found themselves in undisputed possession of the trees they sold them to the nearest dealer and then laid claim to the Government forests to supply their wants. *Mr. Shuttleworth* added that in 1863 a committee composed of the Survey Commissioner, the Collector of Tanna, and the Conservator of Forests was appointed to report upon these rights and privileges claimed by the people in the forests. These privileges consisted in—

(1). Cutting *rab* for manure for rice fields.

(2). Gathering firewood for domestic consumption.

(3). Cutting the inferior sorts of wood for building cattle-sheds, platforms for stacking grain, rice, straw, &c., for the manufacture of agricultural implements, for house-building and house repairs, &c.

(4). Grazing cattle free.

The committee reported that the first privilege *rab* had been met by assigning forest or hill numbers, growing trees, to the cultivators in proportion to their rice fields and giving the occupants full rights over all trees thereupon, teak, blackwood, and sandal excepted; that the fourth privilege of grazing had also been met by setting aside special grazing numbers in the different villages, which were open to the village cattle free of charge; that the settlement of privileges Nos. 2 and 3, *viz.*, the cutting of firewood and inferior timber only remained to be considered, and, in order to arrive at a settlement of these privileges, the committee proposed to divide the existing forest lands in each village into two portions, thus—

(1). Imperial reserve.

(2). Village reserve.

The first to be strictly preserved for the growth of timber, firewood, and to be free of all rights and privileges, and the latter for the use of the village people, who were to be allowed to supply their wants free, but seven kinds of trees were to be reserved to Government and not to be felled without permission.

Government generally approving of these proposals, the demarcation or division of the forests was undertaken by the Revenue Survey Department. But the result was not so satisfactory as had been anticipated.

Under this division the portion of the forest nearest to the village was necessarily, from its position and the convenience it affords to the people, classed as the "village forest," and, owing to the peculiar configuration of the Konkan (Tanna districts), long, steep, rocky hill ranges and off-shooting spurs intervening with cultivated valleys, the lower slopes of the hills with the lands at their base which contain the good soil and the best tree-growth have come into the village forest, in which dreadful havoc has been committed: not only do the people supply their wants with reckless waste and improvidence, but tons of wood are conveyed into the market for sale, while under pretence of *rab* not only side branches, but also leading shoots, are ruthlessly cut, leaving black stems and headless trunks all over the forest, and the entire young growth, which is required to re-stock the forests, is systematically destroyed under the plea that it is "under-growth" or "brushwood," only fit for burning. The work of destruction is very rapid, each man striving to anticipate his neighbour. The imperial reserves, on the other hand, which were intended to be the sources of supplying the market with timber and firewood, consist of the upper hill slopes abounding in sheet rock, indifferent soil, prolific growth of euphorbia bushes, scrub and dwarfed and crooked trees.

Seeing the result of this system of dividing the forests, a revision of the work is now being undertaken, and it is sought to make large imperial reserves, containing good soil and good trees, by adding, to the existing 1st class reserves, such portions of the village forests as are suitable for the purpose. But the people say, "No! The village forest was given to us and is ours, and therefore you cannot have it." We rejoin, "No, it was never given to you; it was set

apart for a special purpose and as that purpose could not be satisfied without destruction to the forest it will no longer be open to you." *Captain Campbell Walker* thought that the State was right in protecting village forests against individuals.

Mr. Brandis observed that we could not at present hope to come to the bottom of these important and difficult questions of forest rights in India, and we could not profitably discuss the whole subject at this meeting. These questions must be taken up by men better acquainted with the law and history of India; but he would mention a few points discussed in the papers which we had just heard. As regards the unreserved forests of Khandesh, he would say that where we reserve a few royal trees only, we cannot expect the productive powers of the forest to improve; it is only a compromise to retard the time of their destruction. We are just now emerging from a mischievous state of attempting to protect large areas,—an idea which is fallacious in itself and which has been productive of endless annoyance to the people. The reservation of limited areas free of all rights is the aim which we must steadily keep before us. (Regarding the *origin* of forest rights, this is a question into which we can scarcely venture to enter at present; we must not however imagine that only those are forest rights which are based on a settlement record or on a distinct grant.) Doubtless in many cases forest rights originate in specific grants in India, as well as in Europe; but in the majority of cases, they have their origin in old usage and custom.) We are in no way justified in setting aside rights of user in the forests which have originated in this manner; on the contrary, we must respect them in India as much as in Europe.

Mr. Bagshawe then read the following paper on forest rights in Jaunsar :—

Forest rights in Jaunsar; or a note on the demarcation and settlement of the forests in parganna Jaunsar, Bawar district, Dehra Dun, North-Western Provinces.

Reason for bringing the subject before the Conference.—A suggestion that an account of the recent demarcation of the forests in Jaunsar might be useful, as tending to elicit discussion on what has been, and what remains to be done in this and similar hill forests, must explain my bringing the subject before you.

Brief history of Jaunsar.—A brief history of the district may make the later portions of this paper clearer Jaunsar originally formed part of the Sirmur or Nahan State. In 1807 it was conquered by the Gurkhas, and again conquered by the British in 1815, since which time it has been under British rule. The area of Jaunsar is about 442 square miles, of which about 30 square miles under cultivation support (excluding the station of Chakrata) some 40,000 inhabitants. The parganna is divided into two parts, that near the plains locally known as Jaunsar, which is thickly populated, and where bare hillsides form a natural feature of the country. The other or northern part called Bawar, where the inhabitants are fewer and where the largest masses of forest are situated. Jaunsar for administrative purposes is divided into 39 *khutts*; a *khutt* is a collection of village communities and is the unit in the present land settlement.

In a land settlement that took place in 1860, the parganna was roughly surveyed and its entire area distributed between the then 35 khutts; a rough division of this description, however, had previously existed, and the object of the more accurate division was to stop disputes and adjust the land revenue.

When the division of the parganna into khutts was thus formally recognised, the right of Government to the ownership of all waste land was protected by a rough limitation of the rights of each khutt in the waste land included in its boundaries.

In 1865-66 the attention of Government was drawn to the forests in Jaunsar by the Inspector-General of Forests, and also by the proposal to establish a military cantonment at Chakrata. This notice gave rise to the issue of different orders for the protection of the more valuable tracts of forest. In 1868 a forest officer was appointed to take charge of them, and in 1869 the demarcation of certain portions as Government forest was directed. As pertaining to the history of Jaunsar, I may here note that in settling the forests with regard to the villagers' rights therein, the position of their former compatriots in Sirmur, and their neighbours in Native Garhwal has been borne in mind, and that the rights of the governing Power have been taken as similar to those held in the Native States, rather than determined by a careful study of usages which had been allowed accidentally to obtain force since our occupation of the country.

Classification of the forest area and reasons for same.—I will now describe the classification adopted in the demarcation of the forests. The classes are three in number :—

1st class.—Forest areas in which the rights of Government are absolute.

2nd class.—Forest areas under the control of Government, but subject to certain rights of usage.

3rd class.—Forest or waste land made over in full proprietary right, barring the right to sell the same, to the different khutts.

The first class requires no explanation.

The second class embraces the larger portion of the Government forests in Jaunsar, and was rendered necessary from the inhabitants in one way or another having had the free run of the whole forest area since our rule began.

The third class was formed, not so much with the view of allotting the villagers a share of the waste land area sufficient to meet all their wants, as to afford a class in which to place land, which from its vicinity to cultivation, it was unadvisable, or useless, to place under the immediate control of Government; or land in which a permanent increase to existing cultivation was hoped for. Later on large tracts of precipitous grazing ground, entirely or nearly bare of forest, were also included in this area. The conveyance of the total area thus formed to the people in full proprietary right was an after-arrangement. The original proposal had been to retain the proprietary right of Government to the land, and this intention was only changed in 1873, as a means of allaying the discontent of the villagers at the more definite limitation of their rights in other forest land.

Method adopted in demarcating the forests.—It will be seen from the preceding sketch that the demarcation of the forests had to be taken up khutt by khutt, and not as a whole. After the examination of a particular khutt, two points had to be decided:—1*st*, if there was waste land of sufficient area to warrant the reservation of a portion as Government forest; 2*nd*, if that area was large enough to admit of any of it being placed in 1st class. When these points had been settled, an outer forest line was laid out, and if first class forest was taken up, the boundary was laid down upon or within that of the 2nd class forest.

For example, in selecting a second class forest in a khutt containing some 2 or 3 square miles of oak forest interspersed with cultivation, and in which nearly all the trees were lopped for fodder, save under exceptional circumstances no area was marked off as Government forest.

The selection of first class forest likewise based on area, and the number of villages having rights therein, was made on various grounds, being partially founded on the value of the forest as regards the kind of timber, and also on the difficulties attendant on its conservation. For example, in a khutt containing 8 or 10 square miles of mixed deodar forest, mostly distant from any village, a block of forest was at once marked off as first class, more attention being paid to getting a compact well-defined block. In another, where the area of forest so available was smaller and near villages, a smaller block was marked off, and as a rule taken up nearest the villages, as being the portion most liable to sustain damage, and most difficult of entire reservation hereafter.

Where cultivated land was included in first class forest it was taken up under the "Land Acquisition Act" and compensation awarded, the only exceptions being where such cultivation had been formed by the destruction of the forest since the last land settlement.

The results of this demarcation were that forest areas were taken up as Government forest in 31 out of 39 khutts, and first class forest marked off in 8 out of the 31. The areas so taken up are estimated at—

1st class forest about	24½	square miles.
2nd „ „	119½	„ „
Total square miles	144	

or about one-third of the area of the whole parganna.

The remaining two-thirds have, as before explained, been made over to the 39 khutts.

I should here mention that none of these figures include the cantonment of Chakrata, which occupies some 6 square miles and, as far as the villagers are concerned, is equal to first class forest.

Rights in the forests and their holders.—The next point for notice is the settlement of rights in the 3rd and 2nd class forests. These rights are held by the different khutts, each represented by one or more headmen called "Siyánas;" the khutt consists of a collection of villages, and a village of a collection of households (called *muásás*) holding land and paying revenue through the zamindar of the same.

It should be clearly understood that the rights are held by the community of zamindars called a khutt, and not by the individual zamindars. Again, the rights follow the land, and when the same is transferred or sold the rights follow it, so that the only way a right can lapse naturally is by land ceasing to be cultivated and to pay revenue.

The local rules for the transfer of land are most complicated and nearly preclude any person not belonging to Jaunsar buying land therein.

In third class forest the rights of the khutts are unlimited save as to the alienation either of the area or any trees grown thereon (save fruit trees) to any use save their own.

Any infraction of this limitation renders a khutt liable to the penalty of forfeiting all the waste land within the khutt. This limitation was made to prevent the third class forest area being denuded of trees and an increased demand made by the villagers on the Government forests.

In the second class forests the khutts within whose old boundary forests have been marked off exercise the following rights within those old boundaries. No payment is made in return, but the forest produce so obtained is for their own use only, and the rights are, as in second class forest, unalienable.

These rights are—

(a).—To graze and cut grass for their sheep or cattle.

(b).—To collect dry wood for fuel.

(c).—To collect dry leaves for manure.

(d).—To demand an allotment of oak and other trees whence to cut fodder.

(e).—To cultivate land measured at the last settlement within the forest boundary.

And against the whole area of Government forests, second class, the 39 khutts have a right to demand annually an allotment of timber for their houses, which is to include deodar if they choose to use saws for converting it.

Against these rights the khutts within whose old boundary second class forest has been demarcated bind themselves not to fire the forest, and to afford immediate aid in case of fires occurring. They also consent to the entire reservation of portions of the second class forest, *i. e.*, to its being considered as similar in every respect to first class forest, when such reservation is required for purposes of reproduction. This last clause is however subject to the proviso that the forest officer shall not close all the grazing in the vicinity of any village and allot all the distant ground as open. Also that in every case a sufficiency of grazing ground shall be left open. The referee in case of differences with regard to grazing is the district officer, and in case his decision is not approved either by the people or the forest officer an appeal is to be made to the Commissioner of the division and the Conservator of the province, whose order is to be final. The closure is preceded by six months' notice given through the district officer.

The rights here noted are recorded in the settlement *wajib-ul-urz* (or "record of rights") which is signed by each *siyána* on behalf of his khutt, and by the settlement officer. Any infraction of the rules is punishable by fine, as "disobedience of lawful orders," in case no other offence is committed. As regards the Forest Department they have been, and are being given force to by the demarcation of the forest by masonry pillars bearing a serial number, by the record field by field of the authorised cultivation in second-class forest, by the preparation of a register shewing the number of households in each khutt,—the number of sheep and cattle in each village, the number of buildings for which timber is required and the class or quantity of timber used. The forests have also been divided into two portions :—

(*a*). Those which may be fired.

(*b*). Those protected from fire and notice given to the *siyánas*.

What remains to be done.—It now only remains for me to note what has to be done in the future with regard to these rights of usage. It will at once be seen that the present settlement is only temporary, and that to effect a permanent settlement, the following information is required :—

(*a*). The acreage required by each khutt for grazing fodder or manure.

(*b*). The quantity of cultivation which it is advisable to allow in forest bounds.

(*c*). The number of cubic feet of timber and quantity of fuel required by each khutt per annum.

(*d*). The extent of 2nd class forest, which it will be possible to make permanently 1st class without interfering with existing rights which it may be inconvenient to commute.

By collecting this information, and getting it, point by point, authorised by the local Government, this department will be prepared with a complete scheme for the forests when the land settlement is revised either in 1880 or 1890.

Dr. Schlich said that he considered the three classes of forest in Jaunsar too many. In his opinion it would be better to have only two classes, for it is well to simplify the organisation and to confine our energies to small areas. *Mr. Greig* explained that there were actually only two classes of forest under Government, those areas which Mr. Bagshawe terms third class being nothing more or less than waste land given over to the villagers. *Dr. Schlich* replied that in that case he would much rather reserve a portion of the 2nd class strictly and make the rest over to the villagers entirely. *Messrs. Greig* and *Bagshawe* said that it was not found expedient to do this all at once, but that ultimately a portion of the 2nd class area would probably be included in the reserves. *Captain Campbell Walker* looked upon the formation of communal forests as most important. *Mr. Duff* thought that it would be impossible to reserve a sufficient area of 1st class forest immediately, and that if we give up any rights now, we shall never get them back again. The arrangements made in Jaunsar would be very suitable in Kullu.

Mr. Brandis said that our aim should be to have certain reserves entirely in our own hands, but that we must also consider what policy should be pursued regarding those forests that are only partially under our control. We must not confine the term 'reserve' to those forests which are entirely at our disposal. Thus in the Patli Dun of the North-Western Provinces we are practically masters, whereas there are forests in Oudh burdened with privileges; yet both are equally reserves. We must endeavour gradually to gain as much control as possible, but at present we have reserves free of rights and others burdened with rights. In Jaunsar the process of converting portions of our 2nd class reserves into 1st class will probably progress slowly, but steadily. In order to ensure a permanent fuel supply to the military station of Chakrata, it has

been found necessary to have five thousand acres of forest free of grazing; and one of the next great changes in Jaunsar will probably be to convert this area into 1st class forest by compensating the villagers who have hitherto grazed their cattle on it, and by providing other high level pasture grounds for their sheep.

In the Central Provinces the unreserved forests are year by year becoming exhausted, the population is increasing, and it is necessary to make adequate provision for future supply. Whether it will ever be possible to form portions of the unreserved forests into regular communal forests is a question for our successors to consider. In some parts of India, such as Mysore, Kumaun and Garwhal, where the old national system of village communities has been maintained, no measure is likely to prove more beneficial to the country or better calculated in every way to improve the moral and material condition of the people than the formation of true communal forests.

After explaining the system of communal forests in several countries of Europe he continued, "We cannot expect that the village communities of India will be at once in a position to manage their forests on strict conservancy principles, but if we at present undertake the task of managing these forests for them, and if we succeed in establishing a simple system of cutting and grazing by rotation, then a time will undoubtedly come when the people will be exceedingly thankful to those who have established communal forests in India."

Mr. Amery said that it was not so difficult to determine the legal status of forest rights as was generally supposed. If they are not defined by law or settlement, they are not rights at all. In the case of communal forests in India, we shall have to administer them; otherwise, their improvement cannot be expected.

Mr. Brandis said that undoubtedly, if communal forests are created, their administration would have to be in the hands of the department, for village communities in India cannot at present be expected to be sufficiently alive to their own interests. In France, all communal forests are administered by the Government for the good of the village community, which receives the revenue either in kind or in money. Any large expenditure on works of improvement must be sanctioned by the municipal authorities. Some such similar system will have to be introduced into India.

Dr. Schlich said that this only proved what he had brought forward, *viz.*, that the portion of the property which belongs to Government must be kept separate from the rest, but that he would not allow the village forests to be destroyed; on the contrary, they should be managed so as to ensure a supply of the material most required by the people. *Mr. Brandis* agreed with Dr. Schlich that the object of forest conservancy was to give a permanent supply of forest produce to the whole country, not only timber for public works but also small building-wood and bamboos for the people, gums, lac, grass, &c., and it was most desirable that, compatible with the steady improvement of its productive powers, the forest should yield the highest possible outturn in material and surplus revenue.

Major Waterfield said that in Hazara he had already proposed a separation of State and village forests. Formerly orders were issued prohibiting villagers from extending their cultivation and from firing their grazing lands, but these had become a dead letter. He had now proposed that certain portions should be set apart for forest and for grazing lands; but he would allow the people to burn the grazing lands and to cultivate within certain limits.

Captain Bailey enquired what amount of grazing land was necessary per head of cattle. *Major Waterfield* replied that the villagers could perhaps give the information asked for, though he did not know himself. *Mr. Brandis* said that these communal forests, if formed at all, must be looked upon as permanent sources for the supply of forest produce. They must be as strictly demarcated as the State forests, and they must not be converted into permanent fields. *Dr. Schlich* allowed that demarcation was necessary, but thought that cultivation might sometimes be combined with forest treatment for short periods at a time. *Mr. Brandis* did not object to this and said it might be specially applicable to Mysore, where dry land on the hills is only cultivated periodically with long fallows between. *Captain Campbell Walker* stated that a commis-

sion had already been appointed in Madras to undertake the formation of communal forests, and thought that they should be managed by the forest officer in connection with the Local Fund Boards.

Mr. Shuttleworth put in the following communication :—"While on the subject of communal forests it would be instructive to mention that in 1824 the Collector of the zillah of the Southern Konkan in the Bombay Presidency, with the consent of Government, issued a proclamation giving over to the landholders and village communities all the trees standing on the lands of their villages, in the expectation that the people having a personal interest in the trees would not only protect the existing ones, but promote the growth of others. The result however belied their expectation; as soon as the people found themselves in unfettered possession of the trees, they proceeded to convert them into money and very soon reduced the hills of Ratnagiri into barren wastes. Government, seeing the result of their measures, issued a counter proclamation in 1852, revoking the former one, and re-asserting the rights of the State over teak and blackwood (royal trees) on all lands, and over all trees in waste lands. But the civil Courts have lately decided that Government, having once given up its rights, cannot re-assume them, except with the consent of the people, and therefore that such trees as are left in Ratnagiri must continue to remain the property of the people.

"The moral deducible from this is that if communal forests are to be established they must not be at the unfettered disposal of the people, but must remain under the management of experienced officers of Government. If once made over to the people, their utter destruction is only a question of time, each man anticipating his neighbour in felling and destroying."

The following paper, bearing on the same subject, by *Mr. Narayen Bulal Oke*, Sub-Assistant Conservator of Forests, Bombay, was not read for want of time :—

Bheel rights and privileges in the Khandesh Forests, with suggestions for their settlement.

Before introducing you to the subject of my paper, it is very desirable to give a short description of the country of Khandesh, and a little account of the habits and dispositions of that portion of the population called Bheels.

The province of Khandesh is an extensive, fertile and well-watered plain, intersected by ranges of low barren hills, at the base of which run numerous rivers and streams flowing from the table-land into the Tapti river.

The natural features of the country, which is nearly surrounded by broad chains of mountains, whose sides are clothed with splendid vegetation, afford peculiar facilities to the wild tribes to lead a wandering life.

This province is bounded on the north by an extensive tract of alternate hill and valley, as its name *Satpúras*, which signifies 'seven-folds,' imports, which are very fertile, and capable of being rendered very productive, and are covered with valuable forests. On the west the great Sukhein range rises steep and stony, whilst the continuous Ajanta hills, which in many places rise almost perpendicular from the plains, bound the province to the south. These hills are partially covered with teak scrub and low jungle, and are broken into deep craggy *khoras* (ravines) inaccessible to all but Bheels, and others who are accustomed to climb.

The above mountains seem to have been divided by the natives into different ranges, such as Arnudee hills, Sathmala hills, and Kalduree hills.

Low sterile hillocks, clad with coppice jungle, separate Khandesh from the rich plains of Berar and Nimar, and form its eastern boundary.

The Bheels appear to have settled themselves long since amongst the rocky ranges of the Satpuras and the Sathmallas, and on the woody banks of the Tapti and Narbada, where, protected by the strong fastnesses of the country, they subsisted, until very lately, partly on forest produce, but more generally on the plunder of the rich landholders in their vicinity, considering the right to despoil the inhabitants of the plain as a sort of privilege and the levying of a tax upon all persons passing through the country in their occupation as a natural right. Thus, the terror which used to be felt by the inhabitants at the atrocious acts of the Bheels was so great that the neighbouring villagers were obliged to leave their country and to seek some other place for their abode.

It is generally believed that the Bheels who resided in the south were more savage and wild than those who resided in the north of the country, for the southern hills were more or less infested with gangs of plunderers who had rendered the plains in their vicinity almost uninhabitable, whereas the Bheels in the north conducted themselves more peaceably. This distinction in the character of the Bheels is attributable to the wide difference which exists between the two localities.

The hills and valleys to the north are intersected by mountain streams that turn and twist, and embrace large tracts of fertile lands abounding with game, and rich in indigenous productions, such as wax, honey, charolee, gums, lac, timber, roots, fruits, &c., and numerous

mohwa trees, from the products of which alone almost every family of Bheels derives even now its entire subsistence.

The purchasers of most of these commodities from time immemorial have been the Banias, who congregate in the vicinity of the Bheel villages and carry on an extensive and lucrative trade in the articles named above.

The Bheels who reside in this direction are possessed of various means of obtaining an abundant support from the rich, spontaneous, and unappropriated produce of the forests, besides cultivating some patches of ground. The majority of these Bheels led innocuous lives in ancient times and rarely resorted to robbery, unless compelled by necessity and excited by intoxication.

The hill districts to the south are mostly barren sterile spots with a scarcity of water, and in a great measure altogether devoid of those natural advantages with which the other side of the country is favoured. The dealings of the Bheels residing in this direction with the civilised people (as Banias, &c.,) being limited, they had to maintain themselves not long ago entirely on plunder, with the exception of those few who could engage themselves in cultivation. This difference partially exists even at the present moment.

A gradual, but steady, change seems to have taken place of late in the character of the Bheels and other lawless tribes, through the humane and kind efforts of the British Government, which succeeded in inducing them to send their children to the schools which have been established for their education, to become cultivators and to settle themselves in places which once used to be the terror of the country, and which are now well cultivated, and their inhabitants amongst the most orderly in the province.

The course followed appears very prudent, as, wherever these turbulent and idle classes seemed discouraged from the pursuit of agriculture, a very moderate assessment or none at all was fixed on the land they cultivated, subject to an increase after a certain period, Government preserving the right of levying such increased assessment, and in many cases *tuccavee* (advance) was allowed for the purchase of agricultural implements and bullocks. The slight loss which the State thus sustained is of little consequence when compared with the advantages derived from this line of policy, which led to the improvement of these turbulent classes.

The above plan was found to be very successful, when every other expedient for reducing to order the wild and lawless tribes of the country had failed, and the result has proved the efficacy of a liberal mode of treatment in reforming a race of men who may almost be said to have considered plunder as their birthright, and who from being the scourge of the country are now quietly engaged at the plough, or employed in preserving the peace of those very districts which they formerly ravaged.

Such of the Bheel population as cannot afford to become independent cultivators for want of cattle and other articles obtain their livelihood by bringing grass and wood from the jungle for sale, and by engaging themselves in the service of other cultivators, who may have valuable crops to protect on the ground, such as sugarcane and garden produce; they also engage themselves as labourers, and when the village to which they belong cannot afford them any employment, they occasionally repair to the neighbouring market. Thus, at the present time the Bheels, instead of being a burden to Government, look to their own honest labour for support.

This tribe is wonderfully susceptible of being worked upon by kind and liberal treatment. By attention to their wants and by shewing great interest in their affairs anything may be done with them.

The Bheels in Khandesh are divided into two classes, Mahomedans and Hindoos; the former are called Tudvees. The exact time of their conversion cannot be ascertained. They do not differ much in appearance or manners from the common Musalmans of the country, but they retain a good deal of the ferocity of their tribe, and are of a discontented and quarrelsome disposition which sometimes renders them difficult to manage. The Hindoo Bheels are generally of low stature, of slight but active make, of plain features, and of very dark complexion. They speak a language of their own and are naturally quick and intelligent; but they are of indolent, dissipated and singularly improvident habits, so much so that even yet they can scarcely be entrusted with the smallest sum of money of their own, as they would in all probability at once make away with it, without any thought of the wants of to-morrow. They eat all sorts of flesh, and have a great knowledge of roots and herbs, which they were occasionally driven to subsist on when in the hills. They marry as many wives as they can afford to support; but they cannot manage without one at least to cook and perform other menial offices, and so dependent are they in this respect that they have been known to come in and surrender themselves on their women being seized. As may be supposed, there is little religious feeling amongst the Bheels; they keep all feasts and festivals, both Hindoo and Mohamedan, with equal zeal, and they are staunch believers in all kinds of "*Jadoos*," or witchcraft; they have also their *Bhuguts* (devotees), who at times pretend to be inspired, and in whose responses they place implicit confidence. Their belief goes so far that if a death occurs amongst their community, even by natural causes, they quit their huts and erect new ones on some other open ground, sometimes migrating to other villages to avoid further attack, as if they could never die but by the effects of *Jadoo* (witchcraft).

With all his faults, however, the Hindoo Bheel is not without some redeeming qualities: he is attached to his own *patell* and his own *naik*; he is kind and affectionate to his own family and kindred, and he is always faithful to his word, of which I have had good proofs.

Such are the people whose reformation has been in progress, and which has been productive of so much good, both to the Bheels themselves and to the country at large.

The plan for effecting this reformation which was so ably sketched out by the late authorities in this district, and followed so zealously by their successors, has proved to be equally wise, politic and humane.

Partial breaches of peace, there may, and will be, because such inveterate habits are not to be changed in a day; but there never can, I think, be a general relapse as long as their wants are provided for, and by degrees the rising generation, inured to labour from their infancy, will lose sight of old times, and gradually become useful, obedient and peaceful subjects.

If a detailed description of the nature and habits of the Bheels were attempted, and a minute sketch of their history drawn, it would contain volumes of useful information, but what has been attempted here is only to give a short account of their career, or rather to mention what appeared to be the more important facts. I shall now proceed to dwell upon their rights and privileges in the imperial forests, and offer a few suggestions for their settlement.

From what has been said in the preceding paragraphs, it is clear that the Bheels had sought refuge from a remote period in the mountainous tracts which surround the province, and which alone are clad with valuable forests, on the produce of which the Bheels heretofore subsisted.

The Satpúras, forming the watershed of the two great rivers which run to the west through the rich plains of Guzerat, and on which their fertility mainly depends, were before a short period denuded of timber by the reckless cuttings, which were carried on by the sleeper contractors through the agency of the Bheels before any conservancy measures could be enforced, when the Bheels and others were prevented from cutting 9 kinds of trees named below :—

Mango . .	...	*Mangifera indica.*
Charolee . .	...	*Buchanania latifolia.*
Teak ...	...	*Tectona grandis.*
Blackwood	...	*Dalbergia latifolia.*
Toewas ...	...	*Dalbergia Oogeinensis.*
Kheir ...	...	*Acacia Catechu.*
Babool ...	...	*Acacia arabica.*
Sandalwood	. .	*Santalum album.*
Moho ...	...	*Bassia latifolia.*

The other species were left alone, and their cutting without permission has not been prevented. The Bheels and other wild tribes can go into a forest and cut any kind of unreserved timber, whether fit or unfit for the axe, as may suit their purpose, and bring it for sale. If carried on carts, a nominal fee of one rupee and one anna is charged per cart, and if removed by head loads no fee is levied.

The bamboos also are allowed to be cut and conveyed on the same condition as timber, but are taxed at the following rates (head loads being exempted) :—

	Rs.	As.	P.
For a cart load	2	0	0
„ bullock load	0	6	0

The Bheels, as well as any other ryots, residing in or near the forest tracts, are allowed to take any kind of timber, except the nine kinds for their domestic purposes free of any charge, and all firewood that they require for burning.

The wretched and poor condition of the wild tribes, caused by their indolent habits, requires a large quantity of wood for their consumption, both to keep their naked bodies warm and to reduce moisture in the atmosphere, without which they can hardly endure the effects of the noxious climate, in which none but hardy denizens of the hills can exist for many months of the year.

They are also at perfect liberty to collect other forest produce such as lac, wax, honey, grass, barks of certain trees for tanning purposes, Moho flowers and fruits, Heerda fruits, mangoes, charolee, a valuable product which is mixed with the milk in Guzerat and which is sold dear, not by the Bheels, but by the Bunias residing in towns situated near the Bheel villages.

Forest conservancy in this district is still in its infancy; but when the demarcation of the forests which is in progress and which is drawing to a close is once completed, and the new rules, which have been lately framed for the management of the Khandesh forests, are introduced, matters will be a little changed.

The above rules provide for the division of the Satpúra forests into two classes of reserve, the one an imperial or 1st class reserve in which no cutting of any sort is to be permitted, and the other a 2nd class reserve in which the Bheels are to have a monopoly of all timber except the nine reserved trees.

It is needless here to enter into the detail of the arrangement; but it must be mentioned that the forests in Khandesh, which are overburdened with prescriptive rights and on which the subsistence of the wild tribes chiefly depends, cannot be better divided than in this way.

Under the above arrangement the large fertile country within the Satpúras, which was once thickly populated and which has for many years been deserted on account of the constant raids of the Bheels, might be marked into one or more blocks of imperial reserve, as may suit the requirements of the department; but the few and small Bheel hamlets which now exist in them may be allowed to remain undisturbed, and their occupiers to cultivate their land free of any rent and to collect all minor forest produce for the department, from which such shares (always in coin) might be given to them for their labour as would induce them to take

interest in forest matters. Of course they will retain no claim as heretofore on whatever land they cultivate.

These men might be allowed small advances, to be recovered at the harvest, and otherwise assisted, and their services might be utilised for the protection of Government property in timber.

The Khandesh forests, which are interlaced with those of foreign territories, can hardly be protected from depredation, even with an army of foresters, unless we have resident watchmen on the spot. Our present staff of foresters, who are unaccustomed to jungle life and cannot endure the effects of the malarious climate, and who do not belong to that class of men which the term 'forester' implies, might be dispensed with under the arrangement suggested.

At the same time it is indeed difficult, nay impossible, to do anything towards the improvement of the enormous extent of those forest tracts, which are situated within the Satpúras, unless they are inhabited by human beings, and no forest work would be profitably carried on if no labour could be secured on the spot.

The resident Bheels, who are peculiarly fit and who possess singular aptitude for forest work, might with advantage be gradually instructed in selecting trees for the axe, in felling operations, in seasoning the timber, in planting, thinning and pruning, in the manufacture of *kath* (catechu), in the propagation of *lac*, in cutting fire-paths, and to do such other works as will ultimately lead to the well-being of the forests in which they reside.

Besides, the great political advantage which will be derived by the adoption of the above suggestions is, that it will tend to keep the Bheels undisturbed and afford means to provide them honest employment for their maintenance; otherwise, they might resort to their old habits and become desperate.

Forest Reserves in Ajmere and Mhairwarra.

Major Repton then read the following papers on the history of forest reserves in Ajmere and Mhairwarra, the first written by himself, the second by *Mr. Saunders*, Commissioner of Ajmere.

Note regarding forest operations in Ajmere and Mhairwarra.

Ajmere came under British rule in A. D. 1818 and till 1850 was administered very much as if it had been a native state under British management.

There are four classes of tenures in the land, *viz.*—

1*st.*—*Khalsa, i.e.*, lands paying revenue to Government, the proprietary right therein belonging to individuals and village communities.

2*nd.*—*Istamrar, i.e.*, estates held on a perpetual quit-rent the proprietary right belonging to the istamrardar, the condition of tenure being recorded in the deed of grant recently bestowed by order of Government.

3*rd.*—*Jaghir* and *maafi* paying no revenue to Government, it having been assigned by Government to individuals, communities, or for religious purposes, antecedent to our rule, the proprietary right not generally belonging to the assignees, except in the waste lands.

4*th.*—*Bhúma.* This is a tenure peculiar to Rajputana and includes a revenue-free holding with full proprietary rights.

Previous to 1850 such a title as "proprietary right" was unknown in these districts. But in that year a settlement was made under the orders of Government for a term of twenty years, and the process of making such a settlement embraces amongst other matters :—

1*st.*—The demarcation of the boundaries of each village.

2*nd.*—A record of existing rights which are acknowledged.

3*rd.*—Decisions concerning rights which may be disputed.

4*th.*—The conferment of proprietary rights (when not otherwise ascertainable).

In this way the proprietary rights in the hills and waste lands of each village were declared and defined, and such properties ceased to be regarded, as they had hitherto been and as they still are in native states, the property of the Government, but they were made over as common property of the village communities, rights of grazing, &c., thereon by the general public according to established custom being recognised and the fees heretofore paid to Government made over to the village shareholders in all Khalsa estates. The demarcation of village boundaries extended to the whole of the district, but beyond this no further records were prepared for the other classes of tenures already described.

The istamrardars are mainly the descendants of the Jodha Rajputs of Marwar, the jaghirdars are chiefly Mahomedans. The Bhumias are mostly Rajputs of different clans. The position of the istamrardars closely resembles that of the Thakurs of Rajputana and the landed aristocracy of England, and minute interference with the management of their estates, which comprise generally several villages, is prohibited by Government. Owing to no records of rights in these estates or in those of the jaghirdars having been made, they have been virtually independent, except in such matters as have come before the regular judicial tribunals.

Maafi holdings differ in no respect from similar properties in other parts of India, but are understood in these districts to refer to small plots lying in Khalsa villages.

In Mhairwarra, which was subjugated by the British arms in A. D. 1822, we have no istamrar, jaghir or bhum tenures; a few small plots of land have been however assigned as

revenue-free for different purposes in most villages, but there are no entire revenue-free villages. There are, however, only two pargannas which belong to the British Government, *viz.*, Beawar and Bhailan. The rest of Mhairwarra is held by us and managed in trust for the durbars of Meywar and Marwar and the istamrardars of Masuda and Kharwa, in consequence of their inability to manage and control their restless and marauding tenantry. After payment of a certain share of the revenues of such trust lands to the British Government the balance is credited to the durbars and istamrardars before named.

The whole of the Aravalli range which runs through the district was formerly covered with impenetrable jungle and offered such facilities for refuge to robbers and as a harbour to wild animals, which together preyed on the people and their cattle, that the Mahratta rulers who preceded the British in the occupation of these districts commenced the demolition of these jungles, and the British officers completed their work with the object of civilising the people and securing their prosperity. No doubt the plan has had the desired effect, for there are no longer harbours for robbers or wild beasts left; life and property are safe; but this change has not been unattended with other and more serious evils.

The rainfall is precarious and there is a great want of fuel. The water, which was compelled to descend gradually into the valleys, now runs down unchecked and causes the channels to silt up. That trees of an inferior description and scrub can and do grow even in the most unpromising spots is amply demonstrated by the existence of such shelter in the adjoining native states where game is preserved, as also in the southern portion of Mhairwarra, which was too far from communications to be speedily denuded of its wood.

It is abundantly established that it is only necessary to exclude cattle and goats to be able to rear any amount of young trees (even in drifting sand) provided that a covering of grass is allowed to grow up so as to protect the young trees in the first few years of their existence against the scorching heat of the sun and the effects of frost. The experiment carried out at Jeypur in drifting sands has, I am given to understand, proved perfectly successful. All our attempts in this direction have however been confined to individual or isolated cases. There has been no large plan of operations, and year by year the want of an uniform well-organised system of conservancy of trees in Ajmere and Mhairwarra has become more apparent.

The presence of scrub and trees on the hills in Southern Mhairwarra attracts rain, as much as their absence in the northern parts of the district no doubt repels it, as there is, at all events generally, more rain in the southern than in the northern portion of the district.

Having taken up as reserves the tracts shewn on the map, it is proposed strictly to conserve first an area at the base of the hill, where the tract adjoins the valley, till it is well covered. This will arrest the scour of the rainwater and form an artificial soil. Another area will be then as strictly conserved higher up the tract in the same manner, and thus gradually the whole of the sides of the hills will be clothed again with wood and scrub. This is necessarily an operation that will require a long time to fully develop, and as the pioneers of the system we must bear the cost, adhering to the principle whatever the financial results may be, if (as we believe) that principle is a sound one.

An annual allotment will be required to be made by Government for an establishment, which for the first ten years or so must necessarily be a large one and may be required till the system has obtained a good footing, when probably, since natives are prone to follow a habit and custom that has been observed for some years, it may be possible to reduce the guards and rely on the villagers themselves to look after these reserves. A further allotment will be required for contingencies for a few years. But the establishment should be employed as much as possible in enclosing the reserves where necessary. I would propose to employ on the establishment as guardsmen whose houses are in villages contiguous to the tracts, as I believe their local experience and connection with the villages will have a marked effect in enlisting the sympathies of the people in the cause of forest conservancy. For without doubt good pay regularly disbursed is a great inducement to good order among a poor people, and if we for a time restrict their rights and privileges we shall be giving employment in so doing to some of their relatives and friends.

The effect of our taking into our employ and training young men of a turbulent race and the altered condition of the people are well shewn in the case of the Mhairwarra Battalion, which was raised as a military body on our subjugation of Mhairwarra with the object of training the people to our rule and teaching them habits of subordination and civilisation. I am hopeful a similarly good result will follow from my proposed arrangement for forest guards. Strangers are ever regarded by ignorant natives with distrust and can neither have that influence or command that assistance which local interests give. That these measures will be directly remunerative for many years to come is improbable. But that they will eventually be so cannot, I think, humanly speaking be doubtful, while the indirect benefits to the country and people cannot be questioned, and any individual hardships that may be occasioned must be fairly compensated. Eventually, when the tracts have been taken up and demarcated and maps prepared with a record of the recorded rights of individuals and communities which have been affected and the plan of conservancy fairly started, the establishment need consist only of a staff of guards with a sub-assistant conservator. all under the control of the district authorities. I believe this will be, for such a system of conservation, likely to work more smoothly, with less inconvenience to the people and with better prospects of success, than the creation of a separate department. Separate departments of Government are not understood by the people of these districts, if at all in India. The district officer is considered sirkar or Government, and no matter what the position of officers of other departments may be they are not comprehended by the people, who are apt to beat such strangers, as is said to be done in our mining districts. It

is essential to the successful working of such a system of forest conservancy as we have got that we should remove as many obstacles as we can and carry out our measures so as to secure the co-operation of the villagers themselves and get them to work harmoniously with us in keeping down criminals and wild animals; for in again making coverts for wild beasts we shall have complaints of the loss of cattle and crops, and it is not impossible that the forest may be again used as a shelter for lawless men, who will live by plunder, and against such eventualities we are bound to protect the public.

A brief account of the steps taken to establish forest reserves in Ajmere and Mhairwarra Districts 1871-75.

THE famine of 1868-69 in Ajmere and Mhairwarra, and the unequal distribution of rainfall throughout these districts first arrested the attention of Colonel Keatinge, V.C., then Agent Governor-General and *exofficio* Commissioner of Ajmere. He considered it likely that the denudation of the hill ranges was probably the cause of the sparseness and inequality in the rainfall of these districts.

2. A long correspondence took place between the Secretary to the Chief Commissioner in the Public Works Department, and the Government of India, concerning the best means to be adopted to acquire lands for forest purposes. It was then proposed to take up five villages which had been depopulated during the famine, and to invite the Inspector-General of Forests to visit the country for the benefit of his opinion.

3. Towards the close of 1869, Dr. Brandis, the Inspector-General of Forests, arrived and inspected these parts, and expressed his opinion that, in the first place, the destruction of the already existing jungles should be prevented. He further proposed to take up for conservancy the principal ranges of hills running through the whole length of the district.

* Secretary to Chief Commissioner, No. 1773.

4. Subsequently, in May 1871, I was appointed* as Commissioner of Ajmere, and in June 1871, the Chief Commissioner forwarded to me the office† files for the two past years and called for a report on the subject.

† Government of India, Foreign Department, No. 217R., dated 3rd June 1171.

‡ *Vide* this office No. 521, dated 5th August 1871.

5. In August I submitted a report,‡ and proposed that, with the commencement of the settlement operations which were then on the point of re-commencement, endeavours should be made to appropriate such plots of land as might be obtained voluntarily from the proprietors; provided that their planting and strict conservation should rest with Government, and that the income should be divided between the proprietors and Government (after the actual cost for each plot had been deducted). I further proposed that immediate planting and conservation of the Nág Pahár and Tárágarh hills, which had been declared to belong to Government, should be undertaken; and I also recommended the appointment of a properly trained forest officer, with the necessary establishment to supervise the work; and, subsequently, when the settlement was actually started, I urged that such a golden opportunity for obtaining land on favourable terms should not be lost, and recommended the appointment of a special forest officer; the Chief Commissioner supported this recommendation.

Secretary to Chief Commissioner, No. 2581, dated 15th August 1871.

6. The Government of India in the Department of Agriculture, Revenue, and Commerce, sanctioned the appointment of Mr. E. McA. Moir as Assistant Conservator, and Mahomed Anwar Khan as Sub-Assistant Conservator, and called for a report from the Chief Commissioner as to the source whence expenditure on account of the forest cultivation should be met, as the Chief Commissioner had proposed a forest fund tax, but subsequently this was abandoned and the expenditure has since been entirely met from the Imperial revenues.

Letter No. 123, dated 25th January 1872.

7. The Assistant Conservator of Forests reported his arrival at Ajmere on the 27th March 1872, and he was then placed (and has since remained so) directly under my orders, as it was considered necessary to combine the civil and forest administration of this district.

8. I then instructed Mr. Moir, immediately after having visited and made himself acquainted with the district, to propose suitable spots for at least five forests of not less than 1,000 acres each. He was to select the land in direct communication with the settlement officer from those villages having an excess of grazing lands; he was then to inspect the hills of Tárágarh and Nág Pahar, which were Government property, as also that of Beer; he was then to propose a scheme for planting them out, to report what plantations he thought would prove profitable and successful, to consider the advisability of starting nurseries, to make enquiries regarding the previous devastation of the forests in Ajmere and its neighbourhood, to submit schedules of any proposed establishment he might require, and finally to make timely application for the budget provision for the same.

This office No. 817, dated 8th April 1872.

9. The settlement officer, Mr. La Touche, was at the same time directed to assist the forest officer in the acquisition of this land; it was not proposed to acquire it in full proprietary right as State forests, but rather to carry the people with us, by re-assuming such lands as they could easily spare and managing them through a State Department for the good of the majority, as we could not expect to obtain the land for nothing; this course I preferred to that of purchasing the land outright. The following were the conditions I proposed to make with the people:—

Vide this office No. 3129, dated 10th December 1872.

1*st*.—That entire possession of these selected tracts be made over to us for forests.

2nd.—That they shall continue to have the right to cut the grass in these tracts, except in such spots as the forest officials may consider for the good of the trees that the grass should not be cut.

3rd.—That, subject to the control of the forest officer they shall be allowed to have such wood as is required *bond fide* for their household requirements or agricultural implements.

4th.—That no rights of way shall be interfered with unless other provision by a *détour* of a moderate distance can be arranged for.

5th.—No grazing or entrance of cattle into these forests to be permitted.

6th.—That no fine shall be levied for trespass of cattle until the forest has been efficiently protected from involuntary trespass.

7th.—That the people shall be bound to assist the Government officers in conserving these tracts, and, if such assistance be given, then two-thirds of the profits of the forest, after payment of all expenses incurred, shall be made over to the former proprietors of the land.

8th.—That one-third profit deducted by Government is reckoned as the interest due to Government for the expenditure of its own monies.

9th.—That the proprietary right in these lands subject to these conditions shall rest in Government for the purposes of forests; if at any time the land be not required for forests, the proprietary rights shall revert to the present owners.

10th—That if wells or tanks or other works of improvement are made by Government, when the land is returned, the value of such works at the time of relinquishment to be repaid gradually.

I also directed that, if the consent of the people could be obtained to these terms, the settlement officer should record a formal proceeding setting out these terms and obtain a duly stamped agreement from the people to this effect, the price of the stamp being defrayed by the Forest Department. I also directed that the land should be made over at once to the forest officer, who will take immediate steps for its conservation, so that the people may understand that we are in earnest in resuming possession of their lands.

The settlement officer, after using his best endeavours to obtain the land, reported that the proprietors failed to see the prospective benefits of the proposed State forests, and he explained at length the difficulty there was in obtaining lands on the proposed terms. He suggested, after a personal consultation with the forest officer and myself, that, owing to the refusal of the people to sign any document making over their privileges of cutting and selling the wood as they might deem best, it would be necessary to prepare a forest ordinance.

Vide settlement officer's No. 33, dated 25th January 1873.

Accordingly I submitted a draft forest ordinance, which made provision for assuming lands on the terms above mentioned for conservation and also for the prevention of the indiscriminate destruction of existing trees and jungle in parts of Mhairwarra where forests still remained.

This office No. 312, dated 27th January 1873.

After considerable delay (nearly two years) the first portion of this ordinance providing only for the resumption of waste lands as forest reserves, was arranged for by its publication as Ajmere regulation No. 1 of 1874 (Forests) on the 23rd December 1874; the second portion of the draft ordinance was not approved of, and, consequently, all existing jungles in village lands which it is not proposed to take over as State reserves, will, owing to the increased value of forest produce, soon become a thing of the past, and, had I not ordered the forest officer at first to take over the four tracts in Mhairwarra now in our possession in anticipation of sanction which was not accorded till two years afterwards, we would not on the publication of the regulation have found any existing scrub jungle or forest to protect, as they would ere this have met with total destruction at the hands of the charcoal burners. These tracts comprise an area of about 60 square miles and have remained in possession of the Assistant Conservator of Forests from that date, and by strict measures of conservancy they have in the last 2½ years considerably improved. Camels which were let loose from Marwar and Meywar in the Mhairwarra jungles were prevented from committing further depredation. Certain parts of these tracts were demarcated, and in places most exposed to the inroads of cattle, stone-walls forming permanent fencing were constructed.

Vide paragraph 18 of this office No. 312, dated 27th January 1873.

Paragraph 20 of idem.

Proposals for wood and charcoal supply to the Ajmere city and Nusseerabad cantonment were made, but, pending sanction of the forest regulation, but little could be done of a positive or progressive nature; the experiments tried chiefly consisted of sowing seed broad-cast and in sheltered places, while sowing in pits filled with good earth was also tried. Of the success attending these and other experiments the Assistant Conservator will himself report.

In August 1873, it was proposed to take over as a forest a plot of 1,000 acres, forming a plantation of protection from the raging hot winds around the cantonment of Nusseerabad; about 100 acres was handed over, but it proved unprofitable and has since had to be abandoned. At the same time, about 160 acres in 6 different estates under the Court of Wards were sown; and about 25 miles of roadside avenues were planted, the funds being provided by the different estates or funds having charge of the roads, supervision only being made over to Mr. Moir.

All Nazul gardens and adjoining lands had been made over to the forest officer from the first, and nurseries established in them to enable him to experiment in the kind of trees suitable for this part of the country, the local funds paying all ordinary charges for keeping up the gardens and continuing to receive the income from all previously existing sources; but

leaving the forest officer at liberty to start nurseries in and to cultivate such portions as had not been previously productive.

The forest regulation having been passed towards the close of December 1874, the operations of the Forest Department gained a legal basis to rest upon in the beginning of 1875, up to that time the whole operations of the department may be considered as entirely experimental.

On the passing of the regulation, the four large tracts in Mhairwarra which had been assumed in anticipation of sanction were taken up under section 8 of the forest regulation. Three other large tracts situated in the Ajmere district were also proposed as State reserves, and probably two or three more tracts in Mhairwarra and one or two more in Ajmere may ultimately be acquired.

A set of forest bye-laws were proposed by Mr. Moir, under section 9 of the regulation. They were adopted partially from the rules for forests in Hazara and other places, and they were sanctioned by the Chief Commissioner and published in the *Rajputana Gazette* of 19th June 1875 for general information. These rules provide for the usual forest restrictions and will be noticed in detail by Mr. Moir.

Vide Secretary to Chief Commissioner's No. 1505S., dated 4th June 1875.

The Chief Commissioner, in addition to the four Mhairwarra tracts, approved of the taking-up of the Sreenagar and Beer tracts, and the Nág Pahár tract in Ajmere, and declarations taking up these tracts were published in the local Gazette, but the taking-up of the Mhowa Beer and Madar Hill tract, and the Tárágarh tract, also near Ajmere city, was deferred until the boundaries had been more accurately defined. In the same letter, the Chief Commissioner sanctioned the retention of the nurseries and plantations as per margin. The Nusseerabad plantation was ordered to be returned to the cantonment committee of Nusseerabad as being unprofitable; also several Nazul gardens, plantations or nurseries (which experience proved were not useful) were ordered to be returned to the (local fund or) district committee.

Vide Secretary to Chief Commissioner's No. 1575S., dated 11th June 1875.

1. Shikast Masjid Plantation.
2. Beawar Parade Ground Nursery.
3. Dilwara and Cheng Plantation.

Thus, I have briefly brought up a history of the establishment of forest reserves in Ajmere to the time when the land had been acquired by the civil department, and made over to the forest officer. We have been particularly fortunate in having the services of an officer like Mr. Moir, who has worked with much zeal and energy, and on no single occasion do I remember to have heard of any unredressed grievance or substantial complaint of hardship to the people. No one likes his land being taken out of his charge, and the boundaries in the four tracts, which we have now held for nearly three years, have had to be altered more than once, to prevent any real reason of complaint, but I believe the combined endeavours of civil and forest officers, in acquiring these forest reserves, have been most beneficial, and may well be continued in a country like this, where true forests cannot be considered to exist, and where any elaborate system of forestry would be out of place.

Having brought the history of these reserves up to this point, the Assistant Conservator of Forests will now treat of the same from a forest point of view. Major Repton, the Deputy Commissioner, having generally explained the land tenures of this part of the country, and the circumstances under which the waste lands were made over to the village communities, the subject may be considered to have been fully reported upon.

Mr. Moir followed with his paper on the same subject—

Forest Reserves in Ajmere.

The following paper entitled the Forest Reserves of Ajmere has been written in connection with a subject upon which an interesting discussion took place at the last forest conference, *viz.*, the method of planting and forest treatment in arid and desolate regions.

I shall first endeavour to give a brief description of the physical features of Rajputana, its climate, its forests, and more specially those of Ajmere and Mhairwarra; secondly, I shall sketch, as shortly as possible, the operations of the Forest Department; thirdly, I shall venture to give a few conclusions arrived at, resulting from the experience gained in these operations, and shall conclude by laying before you for consideration a line of proposed future procedure.

The territory of Rajputana comprises an area of about 114,000 square miles, in the centre of which are situated the two small districts of Ajmere and Mhairwarra, which contain an area of 2,683 square miles, or about $\frac{1}{43}$rd part of the whole area. Out of this area about 791 square miles belong to istimrar, jaghir and bhum villages, so that there is only an area of 1,892 square miles of khalsa lands left.

The greater part of Rajputana consists of undulating plains, the only hills worth mentioning being the Aravalli range, the highest peak of which, Mount Aboo, reaches an elevation of 5,653 feet. Spurs of this range intersect the country in various directions, and more especially the British States of Ajmere and Mhairwarra, by which means their elevation is raised considerably above the general level, so that they occupy what may be called the watershed of Rajputana, the streams on one side flowing towards the Gulf of Cutch, and on the other towards the Bay of Bengal. The district of Ajmere is generally flat with a good many ranges of hills towards the north, none of which however exceed 3,000 feet in elevation. The district of Mhairwarra is much more hilly, and in both districts nearly all the arable land situated in the plains and intermediate valleys is highly cultivated. A considerable portion of the arable land is irrigated by means of wells and tanks, there being in all 607 tanks in the two districts.

These tanks are generally constructed at the points where the streams emerge from the hills, but there are a few whose catchment basin is situated altogether in the plains.

The geological formation of these districts is of a primary character, the hill ranges being generally composed of mica schists, quartz rock, hard sandstones, and a kind of granite in some parts of the Mhairwarra district.

The greater part of Rajputana is situated within what may be called the arid zone, and the remainder is situated within the dry zone, having a rainfall of from 15 to 30 inches. The districts of Ajmere and Mhairwarra are situated on the edge of the arid zone, the average rainfall during the last 20 years being only about 20 inches, and the actual rainfall during the last four years has been as follows:—

		Inches.
1872	..	27
1873	..	25
1874	..	19
1875	..	22 up to 20th September.

A considerable portion of this rain did not fall during what may be called the monsoon, but came down in small showers throughout the year. The average number of days during these four years on which rain has actually fallen during the rainy season has been 33, the remainder having been rainless days, generally with a scorching sun. These breaks have sometimes lasted for 2 or 3 weeks, and have added considerably to the difficulties attending planting and sowing operations. The seeds germinate, but the plants, even under the most favourable circumstances, are scorched before they have a chance of establishing themselves.

Notwithstanding this dry climate, some extensive woodlands exist throughout the territories of Rajputana, it being the custom in most of the Native States to conserve certain tracts of jungle and grass, generally called 'birs,' to furnish cover for game, and in order to give a supply of grass, firewood and small timber, also in other cases certain tracts have been reserved for religious purposes.

I have had an opportunity of examining several of the forest tracts situated in the immediate neighbourhood of British territory, notably those of Kishengurh, Bednore, Rajmahal, and of course found no regular system of working; but Dr. Brandis in his tour through Rajputana in 1869-70 made a more extensive examination, and states that the dhao jungles (*Anogeissus latifolia* and *pendula*) of the Raojee of Humirghur on the Bunas river are worked on a regular system of coppice, all the graduated ages being complete.

But to return to Ajmere and Mhairwarra it must be confessed that less attention has been paid in these districts to forest conservancy until quite recently than in most of the surrounding States. As far as ancient records can be relied upon, both districts are said to have been covered with an almost impenetrable jungle at the time of the invasion of the Mahrattas in 1745, and the rainfall is supposed to have been much more abundant and regular than it is now.

Some of the causes which have led to the destruction of these jungles have been explained in the papers sent by the Commissioner and Deputy Commissioner of Ajmere, but I may add another circumstance upon which sufficient stress has not been laid. At the settlement made in 1850 by Colonel Dixon all the waste lands were made over to the zemindars of the different villages to do with as they pleased. This proceeding, altogether contrary to the ancient rules and regulations of the Native States of Rajputana, has been attended with the most fatal results from a forest point of view, but was no doubt decided upon at the time with the best and most liberal motives, these districts, especially that of Mhairwarra, being in an unsettled state.

The indigenous jungle vegetation of Ajmere and Mhairwarra consists of a variety of scrubby thorny trees which may be classed according to their preference to the hills or the plains.

The hill ranges seem formerly to have been covered with the following trees:—

Dhao or *dhokra* (Anogeissus latifolia and pendula); *saler* (Boswellia thurifera) and a few clumps of *bamboos* (Bambusa stricta).

The following trees seem to prefer the plains and lower slopes of the hills:—

Khair (Acacia Catechu), *koompta* (Acacia rupestris), *orinj* (Acacia leucophlæa), *kari* (Capparis aphylla), *kajera* or *jhand* (Prosopis spicigera), *bir* (Zizyphus vulgaris and zylopyra), *kuddum* (Nauclea parvifolia), *dak* (Butea frondosa), *bur* (Ficus indica), *pypal* (Ficus religiosa), *nim* (Melia indica), *babul* (Acacia arabica), *jhal* or *pilu* (Salvadora persica), *khajur* (Phœnix sylvestris).

These two last are generally found on marshy *reh* land, and, in addition to the above list of indigenous trees, the following trees may be said to be acclimatised, but all of them require considerable attention till fairly established:—

Mango (Mangifera indica), *jaman* (Eugenia jambolana), *mohwa* (Bassia latifolia), *tamarind* (Tamarindus indica), *sheeshum* (Dalbergia sissoo), *siris* (Albizzia odoratissima), *faras* (Tamarix articulata), *chari* (Pongamia glabra).

None of the above indigenous trees ever attain any great dimensions in the dry climate of Ajmere, and I may here remark that in these districts the indirect benefits to be derived from forest conservancy will always be greater than the direct benefits, unless the demand for forest produce increases greatly. This state of affairs results principally from the fact that fine slab stones of almost any length for building purposes are found all over these districts, and timber

used for engineering purposes has never been obtainable in the immediate neighbourhood, at least for many years, and can now be got from Agra or Neemuch much easier than formerly, owing to the opening of the line of railway and the improved state of the roads. With respect to the question of firewood and charcoal, none has yet been supplied by the Forest Department owing to the exhausted state of the tracts in possession, and, judging from the fact that the prices have remained much about the same since indiscriminate felling has been put a stop to, it seems that the supply from other sources is suiting itself to the demand. The villagers and poorer inhabitants of towns use as fuel dry *thor* bush (Euphorbia columnaris) and *oopla*, which they would probably prefer to use, even though other fuel was abundant.

I shall now pass to the second part of this paper, the Commissioner having given an account of the causes which led to the establishment of the Forest Department in Ajmere. I may, however, mention that the result of Dr. Brandis' examination of the forests of Rajputana tended to establish the fact that the state of forest conservancy in Ajmere and Mhairwarra was much more unsatisfactory than in most of the surrounding States.

The first difficulty which had to be contended with was how to get legal possession of the communal lands of these districts, and, after various proposals had been made, it was at last decided that the only possible way of obtaining possession of the waste lands was through a special forest regulation of the Government of India, which was accordingly submitted early in 1873, but not sanctioned till the 23rd December 1874. In the meantime nominal possession was assumed of four large tracts in the Mhairwarra district, which are the last remnants of the once extensive jungles. These tracts were taken up by order of the Chief Commissioner on the principle that, before attempting to execute the *reboisement* of the other denuded hills and starting new plantations in the plains, the first thing to do was to prevent the clearing and improve the condition of the already existing woodlands. These four tracts at the time they were taken up, now three years ago, were generally pretty well covered with a natural growth of the indigenous trees already enumerated, but no conservancy measures having been in force, the natural growth was of course in a fair way of rapidly disappearing. The result of three years' conservancy however has been such that the natural growth is now so thick that pathways have to be cut in order to facilitate inspection. A number of patches of land belonging to the Nazul fund were also made over in the Ajmere district, which have been of the greatest value for experimental purposes and will generally be included in the proposed tracts in that district. A tract of land situated in the neighbourhood of Nusseerabad was also made over by the cantonment committee, and several large plots were obtained in the Thakurs' Estates under the Court of Wards.

The tracts already in possession are coloured in green on the accompanying sketch map, and the proposed tracts which consist only of denuded hill ranges are coloured in red. The area of the tracts already taken up under the Forest Regulation is about 88 square miles, to which it is intended to add several other tracts containing an area of about 28 square miles. This will give a total of 116 square miles or about 4 per cent. of the two districts.

Besides the above, there are three tracts having an area of about 2,500 acres situated in the estates under the Court of Wards, but possession of these tracts is only temporary. The expenditure on these plots is of course met from the funds of the Court of Wards.

The conditions of the Ajmere Forest Regulation prescribe that the present proprietors of these lands shall retain the right to cut as much grass as they choose, shall continue to use roads and paths across these tracts of a defined and permanent character, and shall also be entitled to obtain wood for agricultural and domestic purposes, all which rights are of course subject to the control of the forest officer.

The present proprietors are also to receive a share of the net revenue, but, considering the ruined and exhausted state of most of these tracts situated in the immediate vicinity of the large towns, and the position of others with respect to a market, I have very little hope of there being any revenue to divide for many years.

Section 9 of the Regulation empowers the Chief Commissioner to make bye-laws for the management and protection of these reserves, and a set of rules has accordingly been framed and has received the sanction of the local Government.

Rule II contains all the usual forest prohibitions, a breach of any of which is punishable with a fine amounting to Rs. 50 for the first offence, and Rs. 100 for the second.

Rules III, IV and V ensure the co-operation and assistance of the zemindars residing not more than three miles from the forest tracts to render assistance in extinguishing forest fires and in the case of non-compliance are also subject to the same penalty as for a breach of Rule II. I may here mention that the custom of burning grass for grazing is unknown in Rajputana, the rainfall being too uncertain, so that fires only occur through accident. Rules VI, VII and VIII provide for the arrest without warrant of any one found committing any of the acts prohibited in Rule II, also for the confiscation of wood-cutting instruments.

The remaining rules contain certain restrictions respecting the cultivation of patches of land unavoidably included within the forest boundaries, also the pounding of cattle, the disposal of fines, &c.

I now come to the experimental *reboisement* operations which have been undertaken in Ajmere. It may be as well to state that there are two classes of land to be operated upon, the first being steep hillsides having a gradient of from 30 to 40 degrees and sometimes more, and the second undulating or nearly level land situated in the plains, sometimes of good quality, but frequently of a stony rocky nature. This kind of land has often got beds of "kunkur" at from 1 to 2 feet below the surface, also with patches of marshy *reh* land on which almost nothing will grow except *faras* (tamarisk).

With respect to the first kind of land the following methods have been tried in addition to the strictest conservancy arrangements :—

1*st*.—Sowing broad cast without any shelter except that afforded by grass.
2*nd*.—Sowing below *thor* or euphorbia bush, and in other sheltered places.
3*rd*.—Sowing in carefully dug pits filled with good earth.
4*th*.—Sowing in scooped-out hollow places.
5*th*.—Planting with strong nursery plants.
6*th*.—Planting naked hillsides with *thor* bush in order to form shelter.

On the plains, in the few cases in which land of a suitable nature has been procurable, the following methods have been tried in addition to the abovementioned :—

7*th*.—Sowing after deep ploughing with iron plough with grain crops to form shelter.
8*th*.—Planting and sowing on a system of embankments constructed across the line of drainage so that none of the natural rainfall can escape.

It is perhaps unnecessary to remark that the last two methods are only applicable to nearly level land situated in the plains.

The general conclusions arrived at resulting from these experiments are as follows :—

1*st*.—That on most of the Ajmere hills the stumps and roots of the former trees and bushes still remain and the natural growth will therefore gradually spring up, if properly protected.

2*nd*.—Seed-sowing on barren hillsides is not of much use. The seeds germinate, but the plants die off, either during the breaks in the rains or as soon as they are over principally from want of moisture.

3*rd*.—The sowing of seeds, especially neem, under the shelter of thor bushes, though not attended with so much success as anticipated, should, I think, be persevered in, owing to the fact that 1 or 2 per cent. of the large thor bushes, found in most parts of the district, have generally got a neem tree growing out of the centre, these seeds having probably been carried under the shelter of these bushes by squirrels or birds.

4*th*.—Sowing in pits filled with good earth, though not altogether a failure, does not warrant its being extensively carried on, except in favourable places where there is plenty of shelter and some moisture in the soil nearly all the year round.

5*th*.—The system of sowing in scooped-out hollow places has only been tried for the first time during the present year on a patch of exceptionally good hill land; but, judging from the appearance of the plants, many of which had died when examined on the 1st September, I have very little hopes of this plan succeeding.

6*th*.—Trees planted out in the Ajmere district, even under the most favourable circumstances and after careful treatment in the nursery, must be watered from two to four years according to the soil and shelter. This watering must be done by hand, as the sinking of wells from 50 to 80 feet deep or the construction of costly tanks are much too expensive works for forest operations on a large scale.

7*th*.—The method of planting naked hillsides with thor bush has been tried on a small scale and has met with some success, but the method is a slow one, and the cuttings will take four or five years to cover the soil.

8*th*.—The method of deep ploughing and sowing with grain is only applicable to the plains, and the system has met with some success, considering the capriciousness of the rainfall, but the success has not been such as was anticipated, the few plants that succeeded in establishing themselves having generally been killed or greatly damaged by the annual frosts in the month of January.

9*th*.—The last method, *viz*., a system of embankments, as far as it is applicable to the kind of land in possession, has only been resorted to, where possible, as a last resource on account of the expense of constructing embankments of sufficient strength to resist a sudden rush of water. Several of these bunds have been constructed at the Nusseerabad plantation situated on a plain, and a fine crop of babul plants has been the result on the embankments and immediately behind. The catchment in this case being extensive, rough weirs had to be constructed to allow an overflow. The success of this experiment is further supported by the fact that on all the embankments of the numerous tanks throughout Rajputana fine clumps of babul trees are to be found growing. In some cases the seeds have been sown by the villagers and in others the trees have sprung up naturally, probably through the agency of goats. This system is not, however, generally applicable to the hilly lands of the Ajmere district, but might perhaps be more suitable for the extensive *bar* lands in the Punjab, which, I understand, are nearly level.

Respecting the cost of these different operations, I may here make a few remarks, so that some conclusion may be arrived at as to whether the results to be expected warrant the expenditure—

(1).—With reference to the first method, *viz*., that of simple conservancy, the actual cost at present is about 35 rupees per square mile per annum for establishment, but this can of course be greatly reduced in proportion as the villagers become accustomed to the forest restrictions.

(2).—The cost of sowing seeds broad-cast on barren hillsides allowing 10 seers of seed per acre, will be about As. 12 per acre, but, as I have explained above, this operation is generally a failure.

(3).—The third method, *viz.*, sowing in thor bushes is more expensive as the seeds have to be carefully sown in selected places, but on an average the cost, including seed, has been about Re. 1-8-0 per acre.

(4).—The cost of sowing in pits is an expensive one and of course depends on the number and dimensions of the pits per acre. Some experimental plots were sown in this manner, having about 500 pits per acre. The cost of digging and sowing has, however, amounted to nearly Rs. 70 per acre, which is rather too high to be carried out on an extensive scale.

(5).—The method of scooped-out hollow places, owing to the rocky nature of the ground, costs about the same as the pit system, and in very steep and rocky ground is altogether impracticable.

(6).—The cost of forming plantations in the Ajmere district and watering the trees by manual labour of course depends on the number of trees planted per acre and the distance water has to be carried. Each tree planted costs on an average for digging pit, planting and maintenance for four years about Re. 1-8-0 per tree. If the moderate number of 100 trees per acre are therefore planted, the cost will be Rs. 150 per acre, and even after this expenditure a number of the trees are often killed by the frost and have to be renewed.

(7).—The cost of planting naked hillsides with thor bushes amounts to about Rs. 30 per acre. The cuttings are generally procurable within a quarter of a mile from the hill to be planted, but other expenditure will have to be incurred for filling up blanks from time to time, also for sowing neem seeds when the surface of the hillside is well covered.

(8).—The method of deep ploughing and sowing costs about Rs. 5 per acre, but the result, as I have explained above, is often a failure, and the system cannot be applied to rocky ground or steep hillsides.

(9).—The cost of the last system depends on the height of the embankments, and the distance they are constructed apart. On very flat ground this method has cost Rs. 15 per acre for constructing the "bunds," 3 feet high and 100 feet apart. On steep ground the cost of stronger bunds with rough weirs has amounted to about Rs. 60 per acre.

The cost of tracing fire-lines in Ajmere and Mhairwarra is less than in some other parts of India, owing to the fact that there is very little grass in any of the tracts. Several lines have been constructed for the protection of some of the tracts in Mhairwarra and have cost about Rs. 20 per mile for a breadth of from 30 to 40 feet. Considering, however, the nature of the jungle to be protected the unfrequency of conflagrations, and the fact that the grass belongs to the original proprietors of the lands, I have considerable doubts as to the advisability of spending large amounts for this purpose under these circumstances.

With respect to the fencing of these tracts a few remarks are necessary. Stone-walls 3½ feet high cost from Rs. 6 to 8 per 100 feet, earthen embankments and ditch cost about Rs. 4 per 100 feet, and cactus hedges planted in double lines, 2 feet apart, about Rs. 3 per 100 feet. This last kind of fence does not of course become effective for three or four years, and the advisability of extensive fencing operations, with even the cheapest kind of fence, is a question which also requires consideration.

I shall now conclude with the following observations and trust that you will aid me with an opinion as to their soundness.

The idea of forming plantations on a large scale in the Ajmere district must be abandoned, owing to the impracticability of watering trees by manual labour, and the difficulty of obtaining land of a suitable nature situated in the plains. The *reboisement* of the Ajmere hills must principally be effected by strict conservancy measures, and sowing and planting operations can only be undertaken on a very small scale and in very favourable spots. The best trees to plant in such places will be trees which are valuable on account of their fruit, such as mango, jamun, tamarind and mohwa.

The demarcation of the tracts already taken up has been nearly completed, and rough maps, shewing the boundaries and patches of cultivation, have been prepared. The demarcation of the proposed tracts has now to be taken in hand; also maps and estimates for future expenditure have to be submitted. After these operations have been completed, it is understood that the charge of the forest tracts is to be made over to the district officer, assisted by one sub-assistant conservator.

The forests in Ajmere and Mhairwarra being principally required for their climatic effect, the *reboisement* of the hill ranges is of primary importance, it being generally allowed that the influence of forests situated in the plains is not of so much consequence with respect to their effect on climate. In order that the climatic effect of reforesting the Ajmere and Mhairwarra hills may become appreciable, *reboisement* operations must not be confined to a few

selected tracts, but must be extended gradually over all the hills of these districts, and, if possible, I would not confine operations altogether to British territory, but extend them to some of the hill ranges in the neighbouring States, as the general welfare of the country ought to be taken into consideration.

In order that this may be effected it will only be necessary to retain possession of these tracts until the trees get beyond the reach of goats, when they might again be given back to their former owners, subject to the condition that if a certain amount of care was not bestowed on them, possession would again be assumed and conservancy measures enforced. Other tracts would then be taken up in rotation and put under forest management, till the scrub jungle was sufficiently high to be given up.

If this plan is adopted, it is however necessary to remark that the idea of realising a revenue must be abandoned to a great extent, and under the circumstances it will be advisable to confine expenditure to the cost of an efficient conservancy establishment, and the construction of a few inexpensive fences in places most subject to the inroads of cattle.

By this arrangement the unavoidable hardship of taking up land in some villages, and not in others, will be mitigated to a great extent, and the proprietors of the tracts taken up would have an interest in aiding the Forest Department in conservancy measures, as by doing so their lands would be sooner restored to them for grazing purposes.

Mr. Brandis said that the papers we had just heard were especially interesting, as this was an instance of not merely providing forest produce, but also of securing to the country important advantages of an indirect nature by means of forest conservancy. The famine of 1867, 1868 and 1869 left the districts of Ajmere and Mhairwarra in a most miserable condition. The splendid tanks—some of which had been constructed ages ago, while others had been enlarged or built by the great benefactor of those districts, Colonel Dixon—had proved perfectly useless during that terrible drought. The hills, upon the drainage from which they depended, were mostly bare, for every stick had been cut; and cutting, burning and excessive grazing had completely denuded them. In these districts the rains are most irregular. Torrents, succeeded by droughts, wash down the loose soil from the hill slopes, no longer protected by the roots of grass and shrubs; the streams are silted up below, tanks fill rapidly, bunds overflow and the water is lost to the people. When he visited the district in 1869, he found that in the estate of the Thakur of Bednore, one of the great nobles of Meywar, which adjoins Mhairwarra, the hills were covered with a fair growth of shrubs. The Thakur knew perfectly well that if the charcoal-burners of Nusserabad cut the scrub on the hillsides, the supply of water in his tanks would be uncertain and irregular, and consequently he did not permit them to enter his estate. Lately, however, he (Mr. Brandis) had learnt with great regret that the temptation had been too strong, and that the Thakur had sold the wood over a large extent of his estate. There is no part of India where forest conservancy is more necessary than in Ajmere and Mhairwarra. We must not imagine that by any measures of ours we shall be able to change the climate and to increase the rainfall or to distribute it more uniformly over the year. Even if we succeed in demarcating as much as four per cent. of the district as reserves and if these reserves become completely stocked, no material influence will be exercised on the climate of the country. The great climatic zones of India—the moist, the dry and the arid—are features entirely beyond the control of man, and these we cannot hope to modify. The benefits can only be local, affecting the immediate neighbourhood of the reserves. What we can hope to do is to prevent the loose soil of these dry and stony hills from being washed down the slopes, and to compel the rainwater to run off gradually, and not in torrents. *Mr. Brandis* concluded by remarking that from this point of view these papers were a most important contribution to the history of forest administration in India; and, on behalf of the meeting, he thanked Mr. Saunders and Major Repton for their communications.

Mr. Wallinger remarked that he had found sowing seed broad-cast on dry stony hillsides to be most useful; and now more than 2 lakhs of young plants were in existence, including teak, nim, khair, &c.

Captain VanSomeren remarked that in Mysore they considered closing the forest and strict protection as much more important than broadcasting, which had been looked upon merely as an auxiliary. *Mr. Wallinger* said that he took no such fixed quantity as 10 seers to the acre, but that he sowed the seed by bushels; and *Mr. Shuttleworth* explained that foresters in the Bombay presidency always go about with haversacks, and collect seed from the villages: in the course of a season, one forester could collect a large amount of seed.

District Arboriculture in Northern India.

The Proceedings commenced with *Mr. Coldstream's* paper on the above subject as follows:— Friday, 8th October.

Ever since Lord Dalhousie recorded, in the famous minute reviewing his administration, that the "Punjab was entirely destitute of forest trees," the subject of district arboriculture has received the earnest attention of the Government of the Province.

The circular of the Board of Administration No. 15, dated 1st March 1852, which promulgated certain proposals of the Board made with a view to extend arboriculture in the country may be called the charter of arboriculture for the Punjab. Under that circular favourable terms of revenue settlement were sanctioned on condition of groves of trees being planted, and orders issued for planting all new watercuts and the neighbourhood of Government buildings: while young plantations or copse were declared to be exempt from revenue assessments.

Owing to the opening of the railway the question of the supply of fuel became about 1863 a very pressing one: and attention was anew called to planting both through the Forest Department (which was organised in the Punjab in 1864), and through district authorities.

In a letter No. 513, dated 4th December 1867, addressed to the Secretary to Government, Mr. Arthur Roberts, then Financial Commissioner, remarked that he had for six or seven years observed with regret that little attention had been given by Commissioners and Deputy Commissioners to arboriculture:—

"It is true," he said, "that a separate department for forest conservancy has been organised, and Government rakhs and plantations have been formed, but the vigorous efforts which were made immediately after annexation to induce the people to join in the great and important work of planting trees all over the country have, except in solitary instances, long ceased to be used; neither is the same attention paid as formerly to planting at sudder stations. Little, as far as the Financial Commissioner can see, is being done to extend operations. Some few Deputy Commissioners do not neglect it, but the generality require to be reminded of its importance."

In the following year 1868 the views of the Financial Commissioner took shape in the form of a circular order (Financial circular No. 6 of 1868, dated 17th January) in which the orders of the Board of Administration above mentioned were recapitulated, and the attention of district officers directed to arboriculture "as a question of imperial importance."

In 1868 it was directed that district arboriculture should be conducted under the advice of the Forest Department.

In 1872 the subject was again seriously taken up by the Government of the Punjab and a most interesting and elaborate report submitted through the Financial Commissioner by Mr. Baden-Powell, Conservator of Forests. It contained practical suggestions which were recommended by Government to the attention of district officers. It proposed the publication of a manual on the subject, which was subsequently prepared by Mr. Ribbentrop, and a definite yearly scheme for carrying on planting operations in each district was sketched in the report and immediately adopted by Government. In circulating Mr. Baden-Powell's report for the information and guidance of divisional and district officers, Sir Henry Davis directed that in future the Conservator of Forests should exercise a general supervision over district arboricultural operations. Owing to the heavy pressure of departmental work, however, it was only His Honour's wish that district arboriculture should be attached to the Forest Department for the purpose of general direction of its operations, and to allow district officers to refer to the Conservator on matters regarding the planting, choice, rearing and treatment of trees and nurseries.

"The importance of the question of arboriculture," writes Mr. Secretary Griffin, "is very great, and the Lieutenant-Governor is of opinion that it will with profit be placed so far under the direction of the Forest Department as to secure an uniform procedure and to prevent loss to the State from ignorant and unscientific methods of conducting planting operations."

The result of the attention which has generally been devoted to district arboriculture in the province is that the sudder stations of the Punjab are mostly very well planted, and the same may be said of a great number of tehsil stations. The great good which has already been effected by the Forest Department, in the way of establishing plantations, conserving rakhs and forests, it would be out of place for me to comment on and impertinent to criticise. I am referring now, and will, throughout this paper, refer to the efforts of district officers which I can speak of from experience and which have been, until quite recently, mainly carried on without the aid or advice of forest officers. While, as I have said, the issue has been, in its visible results in large stations, a successful one, it has been attained under great difficulties and at a very large expenditure.

To point out a few of these difficulties, and to suggest or ask your aid in suggesting remedies, and to consider how the expenditure may be reduced, or rather how it may be most profitably applied, is the object with which I have ventured, in answer to Dr. Brandis' invitation, to put together these few remarks; and, as I come before you only as a learner in the science of tree-planting, I must crave your indulgence while you listen to my few words on a subject on which you yourselves are entitled to speak with the authority and confidence of professional science and skill. It might perhaps be objected that the proverb, *Ne sutor ultra crepidam*, might fairly be applied to my appearance among you on this occasion, and well would it be for the interests of arboriculture that it should always be carried on by experts only; but in this, as well as in many other directions in which it is necessary for Government

to use further efforts for the benefit of the country, it would be impossible to have professional supervision to the full extent required. It becomes necessary for civil officers to learn as much as possible of the theory, and especially the practice, of many things, and among these is arboriculture.

The district officer is principally concerned in planting roadside avenues and roadside groves and my remarks chiefly apply to his efforts in this direction.

Since Mr. Brandis asked me to prepare this paper, I have had the advantage of consulting several officers of the Punjab Commission, who have had great experience and success in district arboriculture, and they have kindly allowed me to make use of the notes on the subject with which they have kindly furnished me. Among them are Colonel W. Davies, Commissioner of Jullunder, Mr. George Knox, Deputy Commissioner of Rohtuck, and Mr. Frank Halsey of Madhopoor, and it is right that I should here record my sense of obligation to them and appreciation of their kindness in supplying me with the results of their experience.

The Punjab presents such a variety of soil and climate, from the burning treeless deserts of Sirsa and the Sind Saugor Doab, where the rainfall is less than 10 inches, to the submontane tracts where it is 40 or 50 inches, that a civil officer can seldom accumulate such a stock of experience as will bestead him in every locality to which in the course of his service he may be sent; and even if he retain his zeal for tree-planting all through, his numerous duties do not always leave him time to study the subject thoroughly under a number of varying conditions. He may have planted very successfully in Umballa, but find himself nonplussed when he tries the same system at Jhung, or in a frontier district. The result is, that, even among the most experienced officers, considerable difference of opinion will be found even on the most elementary and essential points. Thus, while Colonel Davies considers that the best time for transplanting is the beginning of February, another gentleman of experience thinks that all deciduous trees should be planted in November or December at latest.

Those who know the history of roadside planting in the neighbourhood of our large stations must be aware that enormous sums of money have been wasted in planting and replanting the same avenue. A fine line of young trees is laid out, carefully watered for two or three seasons, then from some cause or other, perhaps because the soil is unsuited for the kind of tree, perhaps because too much water or too little has been supplied, perhaps from carelessness on the part of the subordinate establishment, the whole line droops and dies: new ones are put in, which in their turn, perhaps, share the same fate, and the cycle is repeated time after time till at last if a line of trees is eventually reared, each individual alive is the representative of ten which have died.

This is no exaggeration, and the experience must be familiar to those whose attention has been directed to the subject.

"Where you see a stunted tree, or a broken or a small one," writes Mr. Knox, "you have only to picture to yourself the history of the spot where that tree stands, say for the last 20 years; and are there not such spots in hundreds and thousands of places in our district stations and roads, where Collector after Collector has planted and watered, and reared and replanted, again and again. No one neglects the planting and watering, but the first Collector leaves and the truth after him, and the avenue is always being replanted, eaten up by cattle or white ants, and so on. For one moment just calculate the expense of a tree which has been watered for five years from a well half a mile away and then dies."

Of course, one would naturally say that it was foolish to plant in such a situation. But it might be necessary or advisable to plant in such a situation; and even several years' watering would perhaps under certain circumstances not be grudged if the condition of success were well ascertained and the issue certain to be successful eventually.

It is quite certain that very large sums are annually wasted by district officers from ignorance and inexperience, and this not in the Punjab only. From conversations I have had with officers from various parts of India, I believe that the very same thing occurs almost everywhere.

A record of the exact conditions under which good avenues have been successfully reared is much needed. One would like very much to know the details of the process which have resulted in the fine row of kikar which run along the Grand Trunk Road a few miles north of Guzrat, in the Shisham (*D. sissoo*) avenues near the sudder stations of Muzaffargarh and Bannu, and in the beautiful avenue of various kinds of trees which borders the main road in the Gurdaspur district.

That success is very far from the constant rule is not only well known to all who have observed the operations carried on from year to year in various stations, but is shewn by the statistics furnished by the districts themselves.

Mr. Baden-Powell in his report of 1872 notes that the statistics of the Syalkot district shew a pretty constant failure of 75 per cent. of the trees planted, and though the accuracy of these statistics is doubted by the Conservator, he remarks other districts shew a failure of 25 per cent. and less.

If these be the proportions of failures shewn in statistics, the compilation of which must usually be left to subordinate native officials desirous to make their own work appear as well as possible, it is natural to conclude that the proportion of failures is enormously large, a conclusion entirely in consonance with the experience of those who have studied the matter. The causes of these failures are sometimes obvious, but not always so. Information deduced from the collation of varied experience is what is much wanted. I proceed to enumerate a few of the points upon which information is desirable.

What are the kinds of trees best suited for groves and avenues?

Two of the most useful and easily grown trees of the Punjab are shisham, sissoo, or tali (*Dalbergia sissoo*) and kikar (*Acacia Arabica*), but, though these have undoubtedly the pre-

eminence as regards quality of timber, there are other trees more adapted for shading roads; the shade afforded by the kikar particularly is very poor, owing to the thinness of the foliage. Nevertheless there are probably no two trees, taking into consideration chances of rearing and size of tree, which are more adapted than these for district arboricultural purposes in the Punjab. Colonel Davies, Commissioner of Jullunder, prefers them to all others. His remarks on the subject of selection of trees are as follows:—

"The trees which I have found best to repay the outlay incurred, in forming roadside avenues and groves, are the *sissoo* and the *kikar*. Both yield first rate timber, the latter does not require much water, and the former after it has reached a height of 10 or 12 feet, or say after the fifth or sixth year, requires little or no attention. Kikar, however, will not bear transplanting, and is best raised from seed.

"In some districts of the Punjab, those bordering on the Himalayas, the mulberry answers very well, but it is quite unsuited to the dryer tracts, where it soon becomes stunted and shrinks up and dies.

"The *bakain* and *sirris* are often grown, but they are both unsatisfactory trees."

"I have not referred," continues Colonel Davies, "to the Farás (*Tamarix*), as it is not a tree that is worth spending much money on; in low lying situations and in soils impregnated with salt, it springs up spontaneously, and to such situations it should be confined, as it is a peculiarly ugly tree, and its wood is useless except for fuel."

Notwithstanding the truth of Colonel Davies' remarks, I have seen places in the Punjab where the *farash* would grow, and grow well, while little else would do so, and in such localities the *farash* is certainly not to be despised. The newer part of the civil station of Lahore called Donaldtown would present a very much more desolate appearance than it does if all the *farash* were cleared away. It is certainly ugly and has a useless barren look about it; but it is very readily grown and requires little attention. Mr. Halsey's remarks on this subject, pointing, as they do, to quite a different conclusion from those arrived at by Colonel Davies, are also very pertinent. He says—

"I think everybody with experience in the matter will acknowledge that there is no hope of roadside trees ever becoming profitable to the State. If trees have to be cut down, a rupee or eight annas is all that will be derived per tree if sold standing; if cut down by Government servants they will fetch more, but the amounts received will be more than swallowed up by the wages of the servants. In some parts of India a considerable sum can be derived from the sale of mangoes growing on the roadside trees, but in the Punjab, or in the greater part of it, it is not worth while to grow the mango in such a position, in consequence of the way in which the tree suffers from frost; the same with mulberry trees; consequently, the object to be gained being shade and beauty, and not timber or profit, I do not think a sufficiently careful selection is usually made of the trees to be planted along the roadside. At present in the Punjab nearly everything gives way to sheesham, while the more common banian and pipal which will grow in almost every soil seem to be utterly forgotten."

I certainly agree with Mr. Halsey that pipal is a better roadside tree than sheesham when you can rear it easily, but planting pipal is, I think, a precarious venture. For some reason or other it is fastidious and will not always thrive exactly where it is put down. At the same time no one can say that it is a delicate tree, or that it requires much watering, for I have seen in the Hissar district a fairly-grown pipal thriving upon the top of a sandhill.

The exact condition of success with this tree is just one of the subjects on which information is required. *The mode of planting* has to be considered. Many trees grow as well from cuttings as from seedlings; others again will not bear transplanting. Colonel Davies has found this to be the case with kikar. Mr. Baden-Powell remarks (No. 471, dated 3rd August 1871, to Secretary to Government, paragraph 61)—

"All cuttings and roadside drains should be planted with tamarisk cuttings or sown with tamarisk seed, which I believe germinates best if first soaked in water. Cuttings can only be put in during rain. The water lodges for some time in all deep cuts and moistens the soil for a long time. The growth of tamarisk in the railway cutting near Montgomery illustrates this."

Various efforts have been made from time to time to raise large crops of kikar, or hedges of the tree from broad-cast sowings and sowings in ditches during the rainy season. Some of these have been successful; but the exact conditions of success are not, I believe, generally known. It is the experience of some officers that kikar trees are impatient of their neighbours' company and do not grow well in masses, but we know that in some parts of India there are forests of kikar. The kikar belt in the Guzrat district on the Trunk Road shews what *can* be done in the way of sowing kikar as a roadside tree.

What are the necessary conditions? If to be sown in a mass broad-cast, ought the ground to be ploughed up beforehand, or not? If so, to what depth? Or is it better to dibble in the seed? If to be sown in trenches, ought the seed to be thrown into the trench or on the side of the bank formed by the loose earth? On the proper answer to such questions probably depends the whole success of the experiment.

The management of nurseries for roadside trees is another most important point—

"It is of importance," writes Mr. Halsey, "that the young trees should not be grown at first in highly manured land; else when transplanted to the roadside they are sure to suffer. Until finally planted out, they should be transplanted in the nursery every year, or their roots will grow so deeply that when the time comes to plant them it will be found impossible to do so without breaking the main root."

Colonel Davies recommends that the young plants should be repeatedly thinned out in the nurseries to prevent their roots interlacing and the consequent injury to transplants, and that the young trees should not be transplanted till they have attained a height of five or six feet. As regards the season for transplanting, Mr. Halsey thinks that evergreen trees, such as mangoes and jaman, should be planted immediately the rains set in, so that they may have

the whole benefit of the heavy rain on them: but that in situations where water can be supplied in large quantities during the hot weather they may be planted during the heat. His view that all deciduous trees should be planted in November or December, instead of in February, which is usual in the Punjab, has already been alluded to.

As regards *soil*, I think it important that it should be thoroughly understood that there are some kinds of soil which will never grow satisfactory trees of a certain kind. The recognition of this fact and some general descriptions by which such soils may be recognised would save much time, trouble and expense. Among such soils is notably that impregnated with "reh" or "kallar," on which the better kind of trees will not thrive; and, though the matter seems self-evident, it requires to be borne in mind in district tree-planting that, if the water supply be at all distant, say more than a quarter of a mile at the outside, watering trees by hand is a most ruinous procedure, and it will in most such cases be the wiser policy not to plant at all.

How is the ground to be prepared on the roadside for the young tree? A good big hole three feet wide and three feet deep filled with good loose soil is the proper *nidus*. These will not be properly prepared by coolies unless the supervision is effective. Mr. Knox has found great benefit from digging a trench round each young tree to retain as much moisture as possible.

I will quote his own remarks—

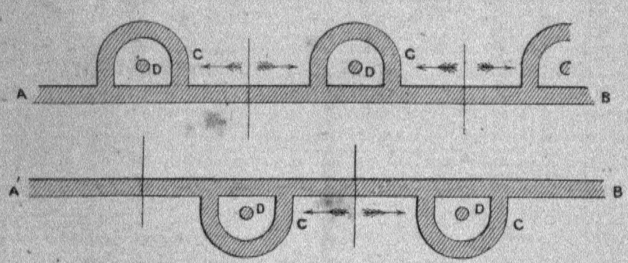
"The first thing that is striking to an ordinary observer is that he will find, generally along the roadside where there are good trees, there is generally, if not always, this cause, *viz.*, a natural or artificial depression in the soil where the rainwater collects.

"I am alluding to dry districts like Rohtuk. The only avenue of good trees we have here is where there is a good ditch all alongside,—a good 6 feet broad by 6 feet deep.

"Have you not noticed on the sides of the Grand Trunk Road the number of kikar trees on the side of the road down in the excavation made for supply of material to the road? There would hardly be a kikar tree there were it not for the hollows where the rainwater collects and moistens the roots. But the aggravating part of that road is that, although there are hundreds of miles of shade that one can see from the dâk ghari, there is not one tree that gives its welcome shade on the road where it can be of any use. I have tried, in order to secure a supply of rainwater, to get a half-moon trench round every tree on the roadside, so that, irrespective of the energy of the bhisti, we may at least hope for about 20 massaks of water at every good fall of rain. This is very easily managed by digging as shewn in the accompanying sketch.

ILLUSTRATION I.

Mr. Knox's system of roadside trenches.



A B, A'B' represents two continuous trenches, one on each side of the road. They are 2 ft. broad by 1½ ft. deep.
C C C Semicircular trenches 2 ft. broad by 1½ ft. deep.
D D D are the trees.

Note. Captain Wood suggested at the Conference that the ground between two adjacent half-moon trenches should be sloped off as shewn by the arrows.

"The space between the straight parallel lines is supposed to be the road; the spots opposite the figures, trees; the shaded portion, a trench, say the straight part 2 feet broad by 1½ foot deep; the semi-circular portion, ditto; so, if the road level is properly managed, every drop of rain that falls on the road and in the trench is utilised. After a good shower of rain, each semicircular trench is well filled. The water sinks down by degrees and does incalculable good to the roots of the tree, long after the rainfall has been forgotten. Of course, keep the bhisties if you can afford it, but our great mistake, I take it, is that we let the rainfall come and go and do not make the most of it."

Mr. Amery, following the same principle, has suggested that whenever in dry districts earthwork is done for roads, &c., it should not be taken from the side over a large flat area, but cut out of trenches of moderate depth, which would then be left ready dug for tamarisk growth. (Mr. Powell's letter No. 471, dated 3rd August 1871, to Secretary to Government, paragraph 62.)

The proper distances at which the various kinds of trees should be planted is another point of material interest.

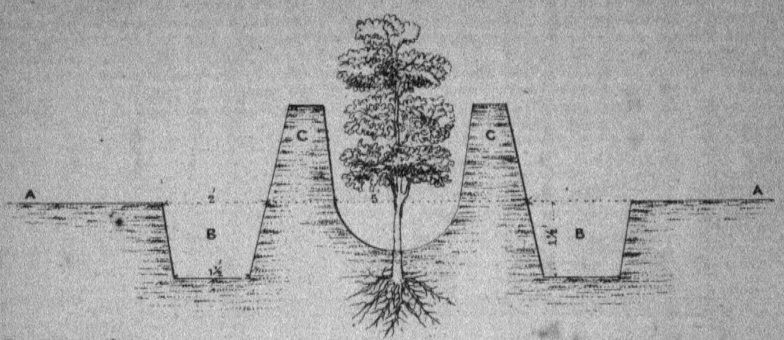
Then arises the question of *protection of young trees*—a most important point. Fencing for single trees must always be rather expensive, but it is very difficult in many parts of the country to keep up a continuous railing or hedge right along the whole line as recommended by Mr. Baden-Powell, and the question of the best kind of fence for single trees must constantly arise and be decided by the civil officer. Fencing is very often done in an inefficient manner to the ruin of the trees and waste of all the sum expended, and what is the most effective, cheapest and best-looking fence is not always easy to decide. There is in practice a great variety in the kind of fence adopted. There is the primitive mud wall, with or without

openings below; the brick wall with or without openings; the hedge of dry thorns; the fence of rustic woodwork; of bamboo; of basketwork of bamboo; and of basketwork of cotton stalks. I have no doubt there are many other kinds used. I have mentioned those which rise readily to my recollection. Now, the choice of hedge will, of course, depend on locality. Where the soil is sandy, mud walls are inapplicable, and in many parts it may be difficult to get bamboos, timber, or even thorns. But I am sure that the communication of experience on the subject of fence is very desirable. It is not always easy for a district officer to make the most prudent choice. Dimensions found to be suitable for each kind of fence should be recorded. I had been 12 years in the country and had always taken an interest in tree-planting, but had never seen a basketwork fence of cotton stalks (*bansatti*) till I went to Rohtuk where they had been introduced by Mr. Knox. It is an admirable protection for trees in certain circumstances, and, being cheap and easily made throughout the Punjab, should, I think, be better known. The result of Mr. Halsey's experience of fencing roadside trees is as follows :—

"The protection of young trees is most imperfectly carried out. It may be that the only method available is the ancestral mud wall, but, whether this or any other method be adopted, they should be made high enough and of such a diameter that cattle cannot probably injure the tree. A circular hurdle of (*tamarix*) "pilchi" is an admirable protection, because white ants cannot injure it; or a stiff hedge of dead "beri" bushes (*zizyphus*). Mr. Knox's plan, as he explains it, is to build a small Martello tower round the tree with the mud of the trench which he digs round it."

ILLUSTRATION II.

Section of Mr. Knox's "Martello Tower" for tree protection.



A A. Level of ground.
B B. Section of trench dug round the tree.
C C. Section of mud wall built of mud taken out of the trench B B.

This plan has the advantage of using little earth, as the wall is practically increased in height by the depth of the trench. As I have said, I know that a great deal of money is wasted on fencing because a district officer does not know what kind of fence is best and most economical under the circumstances of a particular district.

With regard to *watering young trees*, Mr. Halsey has these remarks :—

"It is a very common custom in parts of the Punjab, where canal water is available, to flood young trees for two or three years after they are planted and then entirely cut off the water. This is certain death to the tree. Canal water, in quantity, should only be given when necessary; during the first hot weather after planting, perhaps three times."

The *thinning and lopping* of trees are points very imperfectly understood as a rule by non-professional men. With reference to lopping, Colonel Davies remarks :—

"This is resorted to to such an extent, and is done in so injudicious a manner, as to completely destroy the beauty of the avenues by detracting from the beauty of the individual trees composing them. Trees are in the first instance grown too close together, and when they begin to interfere with each other's growth, instead of thinning them out judiciously, an order for lopping is issued, and the work is entrusted to a number of ignorant chaprassies. The result is that, instead of having avenues composed of handsome wide-spreading trees, each a picture in itself, such as we are accustomed to see in a gentleman's park at home, we have a hedge composed of abortions."

Colonel Davies remarked that in one district he realised in one year Rs. 20,000 by thinning out trees in the roadside avenues. People, he says, yelled at first; but in two years they saw the effect it had on the trees left standing, and admitted that he was right. By that time the trees had spread out to twice their former breadth, and no one would have known that a tree had been taken out; whereas, if lopping had been resorted to instead, each tree would have become a bad imitation of a poplar.

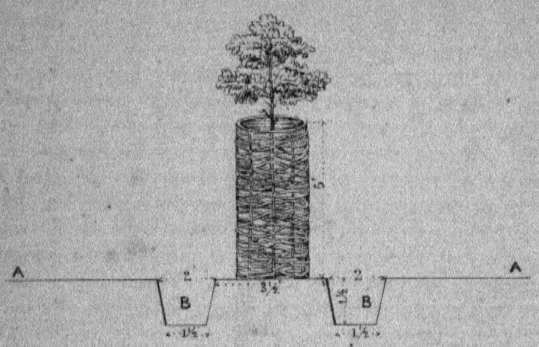
In writing on the same subject, Mr. Halsey remarks :—

"In some instances, as on narrow roads, the branches must be cut away occasionally; but when this is done, it should be carried out by skilled woodmen, and not by the nearest village carpenters who cut the branches half through, a foot off from the stem, and then allow the branch to fall by its own weight, the result being an unsightly and dangerous wound to the tree from which, if the branch be a large one, it rarely entirely recovers."

I have now enumerated some of the points upon which the spread of information is desirable, and confirmed my own experience by quoting the experience of others much more valuable than my own, which they kindly put at my disposal for the purposes of this paper. I have also mentioned some plans and precautions and suggestions on various points which may be deemed of more or less interest, or practical utility to district officers. But I feel I should apologise for introducing remarks (some of which must appear trite to you) in an assembly like this. You will, I feel sure, excuse me under the circumstances, recollecting that I rather endeavour to lay before you the fact that ignorance on the subject is wide-spread, and supply of knowledge therefore a desideratum.

I do not think that full experience on the subject, applicable to the whole of the north of India, has yet probably been gathered up by any one man. Mr. Baden-Powell has already rendered us the greatest service by introducing system into district operations; and in his report he has given us many valuable suggestions. Mr. Ribbentrop has also produced a valuable manual on planting; but he has not, I think, regarded the subject sufficiently directly from the district officer's point of view. He treats less of avenues and groves than of plantations and nurseries. Mr. Powell's report, while containing numerous suggestions, is not intended as a full practical guide to officers. I do think it would have most useful results if an officer were appointed to go from district to district, making notes of what he saw in the way of district arboriculture, and the planting of station roads, collecting experience, judging of what appeared successful or the reverse, and finally publishing his results in the form of a short practical treatise with full illustrations and detailed directions.

Note.—In a recent communication Mr. Knox informs me that, instead of a wall made of the mud dug from the ditch, he has found a fence of *bansatti* or cotton stalks to be practically better. This fence costs 7½ annas only, as any amount of *bansatti* can be obtained for the expense of carriage after the cotton has been picked. These fences (5-feet high by 2½ feet diameter) are made into a sort of wickerwork and are strong enough to last for 2 or even 3 years, provided they are looked after and protected from white ants. An illustration of the ditch and *bansatti* tower is annexed.



Mr. Brandis thanked Mr. Coldstream for his paper and said that he had kindly assumed that we forest officers knew more about avenue planting than district officers, whereas, in fact, we often knew less. Our attention had been directed to the growth of trees in compact forests, and we were apt to forget that there were many other branches of arboriculture of considerable importance. The extension of shady avenues will be exceedingly beneficial in a dry climate like the Panjab, and although we cannot there expect to emulate the great avenues of moister regions, still great changes for the better have been brought about by the introduction of trees along roadsides and near stations.

The aspect of the stations of Multan and Jacobabad, both situated in the most arid region of India, has changed completely by the planting of trees, but in that climate such results are only possible where water is available. As our work progresses, we shall become more and more familiar with the *mizaj* of trees, and, doubtless, shall then be in a position to give good advice to district officers in the matter of avenue-planting. *Mr. Brandis* then requested those present to communicate their experience in avenue-planting in different parts of India.

Mr. Horsley remarked that Mr. Coldstream had not mentioned the system of nurseries. In the Bombay Presidency there are chaukis, about 20 miles apart, where often a good supply of water is available. Plants are reared in earthen pots till they attain a height of about two feet, when they are transplanted into prepared pits on the roadside, and are not watered. This is an inexpensive method and succeeds well.

Mr. Calthrop said that in planting, three main points have to be considered, *viz.*,

1*st.*—Time of planting.
2*nd.*—Mode of planting.
3*rd.*—Species to employ.

In the Panjab the roadside trees are for the most part deciduous, and it has been urged that they should be planted in the cold weather; on the other hand, irrigation canals only flow in the hot weather. It thus becomes a question whether it is better to plant in winter without water, or in summer with water. With regard to the mode of planting in a kankar soil, a deep hole must be made, and in this case the expense is great. He believed sissoo (*Dalbergia Sissoo*) to be the most suitable species. Kikar (*Acacia arabica*) had been employed, but afforded little shade and was susceptible to frost. After sunset it was hotter under a kikar tree than out in the open, a statement that was corroborated by *Mr. Dunbar*.

Major Waterfield thought that planting in gharras succeeded very well, and stated that at Gujrat a narrow strip is ploughed up on either side of the road and the seed sown just before the rains. Kikar is well adapted for transplanting, and the transplants prosper better than those not so treated. Young kikar is frequently eaten by rats, but generally springs up afresh. At Peshawar, bânian trees grow easily from cuttings, even in bad soil. The mulberry, too, does well, and the siris is only leafless for about two months. *Pinus longifolia* has succeeded at Abbotabad, the seed being sown at the commencement of the rains, and it has the advantage of not being browsed, whereas goats and camels destroy the kikar. In Hazara, specimens of nine kinds of *Eucalyptus* grow well, and *E. Globulus* has at the age of seven years attained a height of 60 feet with a girth of 3½ feet. *Dr. Schlich* said that his experience in Sindh led him to believe that it was really hotter under a kikar tree than elsewhere. This he attributed to the kikar tree's greater powers of absorbing moisture from the air. *Mr. Amery* said we should plant when the soil was moist. *Mr. Vincent* observed that the main desiderata were good nurseries and the restriction of the size of planting area. In Multan the planting was done by the district officers, and then the avenues were handed over to the care of the zemindars, who received a few annas' reward for every tree found alive after 3 years. *Captain Van Someren* stated that there were upwards of 3,000 miles of beautiful roadside avenues in Mysore. These have been planted by the district officers who, under the old village system, got the ryots to do it for nothing. In Mysore splendid avenues existed long before British rule. The finest avenues are those of the dupada tree (*Vateria indica*), near Anantapur and the old city of Nagar. The soil round the trees is broken up in the hot weather and left in large clods, and by this means the power of absorption is greatly aided, and free access of air is given to the roots. Where avenues cannot be got to grow, babul is planted in groves, but this method is expensive.

Mr. Wallinger did not agree that kikar was an inferior avenue tree. It afforded an excellent shade, and the flowers smelt sweetly. In Bombay large furrows were made along the roadside, and small embankments were raised, on which large quantities of seed were sown, and this was a cheap plan. *Mr. Wroughton* observed that the engineer in his district economised labour in watering by having a gharra buried near the foot of the tree, which was filled with water once in ten days. The water infiltrates very gradually and a constant moisture is kept up round the roots. *Mr. Horsley* said that a good system existed in Khandeish, *viz.*, that every man who planted and kept up a certain number of trees had his name inscribed on a stone erected by the side of the road. *Mr. Gibson* found that a few pods of *Dolichos pruriens* placed round the young plants kept away the rats.

Dr. Henderson said that he raised his seedlings in pots at a cost of Rs. 20 per 1,000 plants. Sissoo and tamarisk were the principal kinds employed. If transplanted immediately after rain, the sissoo roots descended 3 or 4 feet that year. For 10,000 trees that have actually lived, the cost was Rs. 400. *Mr. Amery* stated that in the Punjab, in 1865, Government first decided on establishing large plantations in the plains. Kikar was the tree first selected, but it never succeeded, except on sandy soils, and then only attained 16 feet in height. Sissoo was then tried in trenches, but failed. Planting on ridges

was afterwards adopted with success. *Mr Brandis* said that where, in the plantations mentioned by Mr. Amery, sissoo and kikar were sown in equal proportions, the result has been a forest of sissoo. It has not as yet been found possible to raise kikar forests on a large scale west of the Bias.

Mr. Coldstream thanked the members of the Conference for the useful information he had received; he thought that in these matters the question of the co-operation of the villagers was of the highest importance.

Mr. Shuttleworth communicated the following remarks:—

In the Bombay Presidency, Dr. Gibson, the first Conservator of Forests, many years ago drew up a memorandum of instructions regarding roadside planting, which was published by Government and circulated among district officers; it details the trees that should be selected for the purpose and the system of planting to be pursued, and the results of this work are to be seen in the fine roadside avenues to be met with in the Dekkan, Konkan and Guzerat, the three principal territorial divisions of the Presidency.

In the Konkan, which is the narrow strip of country between the foot of the ghâts and the sea, the chief trees chosen for roadside planting are—

1. The mango, which grows into a magnificent tree, tall and shady.
2. The tamarind.
3. The babul.
4. Warr—*Ficus indica*—and others of the fig tribe.
5. Casuarina, which, when closely planted, is very shady.
6. Karanj—*Pongamia glabra*—on the coast.
7. Bhendi—*Thespesia populnea.*
8. Oondi—*Calophyllum inophyllum.*

In the Dekkan and Guzerat, the babul, mango, tamarind and bamboos.

The trees are raised either by cuttings put into the ground shortly before the rains, or by seedlings grown in a nursery in small bamboo baskets or sun-baked clay pots, and when once put into the place, the trees are to occupy, are left to nature; they are transplanted immediately before the rains, and thus have the benefit of four months' rain-fall and the advantage of the heavy dews that prevail from after the rains to January. Fences of prickly pear, and varieties of the milk bush (*Euphorbia*) are put round the young plants. Babul succeeds when sown thickly on loose embankments on deeply ploughed ground and forms a good shady roadside tree. It should not be pruned, but if too thick, should be thinned out. Dr. Gibson recommends that soon after the rains the earth round the stems of the plants should be broken up to allow air to reach the roots, and that once or twice during the dry season the same course should be pursued, and that just before the rains the earth should be banked up round the stem.

Mr. Brandis said that the species of *Eucalyptus* cultivated on the Nilgherries were brought from temperate parts of Australia, but that other species were found in the tropical regions of the same country; and it was possible, but by no means certain, that some of these might succeed in the plains of India. *Colonel Thuillier* asked at what minimum distance a fence should be placed round a tree so as to effectually protect it from cattle. *Mr. Coldstream* thought that the fence, if sufficiently high, need not to be made far from the tree. *Mr. Wallinger* observed that *Opuntia vulgaris*, otherwise called "touch-me-not," was most effective.

Treatment of Teak Coppice.

Mr. Fernandez then read the following paper on "The Treatment and Management of Teak Coppice in the Central Provinces."

The object of this paper is to sketch out in broad lines a general plan of management and treatment for the major part of the teak forests of the Central Provinces, with a view to ultimately preparing them for conversion into regular high forests, on the natural regeneration system, and this without neglecting considerations of economy, revenue, and the satisfaction of the wants of the present generation.

Teak is found plentifully over nearly the whole of the Central Provinces, but it is chiefly abundant in the western, central and southern districts. A line drawn from Sāgar to Damoh, thence to Mandlā and Rāipūr, and continued afterwards nearly due south, marks the northern and eastern limit of that species. The districts included within this line and the western and intercepted portion of the southern boundary, possess an average annual rainfall ranging from 32 inches in Nīmar in the extreme west, to 62 inches in Jabalpūr towards the

north. Night frosts are pretty frequent nearly everywhere from the middle of December to the middle of February; while during the hot season, from the beginning of April to the early part of June, the highest temperature in the shade varies from 102° to 113°F. These climatic conditions, coupled with the fact that most of the area is on the limits of the station of teak, would, *primâ facie*, lead one to expect inferior growth. And this is borne out by actual fact. A few tracts excepted, such as Ahiri, the Upper Godavery District and, perhaps, two or three others, the Central Provinces' teak is essentially a middle-sized, and, in some places, even a small tree, reaching under the most favourable circumstances an average height of 50 feet, with a girth of from 3 feet 6 inches to 4 feet 6 inches. Of course, exceptional trees attain a larger size, but proposals for general treatment and management can take into account only average conditions.

Before proceeding further, it is necessary to define the class of forests to which the remarks that follow are intended to apply. Although the so-called teak reserves are very large (witness the western division, which consists entirely of them), still they contain extensive areas that are now either pure maidans and under cultivation, or contain only an insignificant sprinkling of teak in crops where other valuable species of a large size are predominant. Hence, as a first step, I would propose a sub-demarcation, clearly defining the real teak-bearing tracts, which would also contain small patches of maidan or other forest that require to be assimilated with them for administrative or cultural purposes. Wherever promising teak tracts belonging to private proprietors could be obtained in exchange for the residual inferior portions, they also should be included. We would thus obtain about 1,200 square miles of teak-bearing land. To this I would add the best portions from the unreserved forests, such as Chāndgarh, Piplod, small tracts near Būrhānpūr, Sohāgpūr, &c., &c. The present reserved area is manifestly too small for future wants; it must be increased sooner or later, and the earlier this is done, the greater the chances we have of finding something worth conserving. Hence my proposal is nothing more than the carrying out of a foregone conclusion. The objection that the present forest establishment is too weak to look efficiently after a larger area than it has at present, is, to say the least, trivial. What we want at present in the Central Provinces is, not so much a larger number of officers of the higher grades, but a proper employment of those we have, and a better class of men as foresters and forest rangers, whose ideas of their duties rise above details of forest police and collection of revenue. Another oft-repeated objection, that a sudden increase of the reserved area will introduce restrictions which the people will regard as wanton oppression, is equally trivial. No doubt, the system hitherto pursued of closing the forests against all cutting and grazing is felt as a great hardship by the surrounding population. It originated in an entirely mistaken idea of forest conservancy and management; but it is now rapidly giving way to more enlightened views, and when these prevail to their full extent, I venture to assert, in spite of the cant that the Forest Department is the oppressor, and the civil authorities the friends, of the people, that the people themselves will admit that we care for their interests quite as much as the administrators of the unreserved forests. My experience in one district at least is not favourable to the latter. But I have been digressing.

The plan sketched out above will give us a total of about 2,200 square miles under teak. This should be divided into two classes:—

I.—All tracts of a sufficient size to form each a working circle (not less than 3,000 acres), which contain a tolerably full crop, or which, though at present ruined, have, to our *certain* knowledge, produced large quantities of first class timber.

II.—All the rest—area 2,000 square miles.

The first would most advantageously be treated as high forest, or at once taken in hand for direct conversion into high forest. The reasons are obvious, and do not concern this paper, which will deal exclusively with the second class.

A very small portion of this area, distributed in small patches, would consist of more or less full coppice of nearly pure teak, as in parts of Sāoligarh, Khāmāpūr, &c. Elsewhere the teak would be mixed in varying proportions with other species, forming with them crops of varying denseness.

A common feature of the whole area will be a predominance of wretched coppice, the greater part growing on old, stunted, and, in many cases, hollow and decaying stumps several feet high. For this very reason this coppice is unable, under the most favourable circumstances, to reach anything beyond the dimensions of fair sized poles.

As a rule, the teak of the Central Provinces yields a denser, tougher, stronger and more oily wood than the specimens I have seen of Burma teak. Sometimes it is beautifully mottled, and if it could be obtained of sufficient size, would form a first-rate wood for the cabinet-maker. The durability of its sapwood is well known: thin poles, nine inches in girth, require very little seasoning to last at least twelve years, especially in the interior of houses.

Though the process of germination is protracted, teak reproduces itself by seed freely enough; but in the present state of our forests, this reproduction is very far from being uniform, and in some instances is very capricious. You find small patches here and there with a complete crop of seedlings, while in the surrounding portions, the soil being to all appearances the same and the number of seed-bearing trees larger, you meet with one or two seedlings after a long hunt. This remark is true even of blocks of forest preserved for several successive years from fire. For instance, take Bori, which has been thus protected for the past eight years. The formation is the Mahadeo sandstone of the chalk period, the rainfall is good, the drainage system excellent; nevertheless teak reproduction is not at all satisfactory. The

greater part of the young growth, which has frequently been mistaken for seedlings that have sprung up since fire has been kept out, consists of shoots from small stumps which used annually to be burnt down before that time. Large open glades, or complete banks covered with tall grass, low, dense, shrubby growth in the fuller parts under which no seedling can survive—such are the principal causes of unsatisfactory reproduction. Cut away this growth and it will be replaced by the grass and admit of the full action of destructive atmospheric influences.

During the first year teak seedlings in the forest are from 2 to 4 inches high, with small leaves (about 2 inches long on an average), and of more or less herbaceous texture, and hence exceedingly sensitive to drought and frost. The second year they may attain a height of from 4 inches to 1 foot, but the average approaches the lower limit. It is only about the 6th or 7th year that their growth in height becomes rapid and they are able to get above the grass.

Reproduction from the stool, on the other hand, is nearly all that can be desired under existing circumstances. Everywhere the teak coppices freely and vigorously till an advanced age, certainly beyond 100 years. A remarkable peculiarity is the wonderful vitality of the collum, or region where the stem and root fade into each other. It is not uncommon to find large saplings killed outright from crown to base by frost, fire, or drought; but soon after the beginning of the rains the collum throws up a dense mass of shoots, from the midst of which the dead sapling stands out in conspicuous contrast. It is not only when the aerial portion is dead that the collum throws up shoots; a few shoots spring up also when the tree is unhealthy and the base receives sufficient light. It is interesting to inquire into the origin of these shoots, that is to say, whether they are suckers as many maintain, or merely ordinary branches resulting from the development of dormant or adventitious buds of the stem proper.

In 1866, the year after the road from the Sonbadra to Bori was made, Captain Doveton observed a few teak shoots on the road, which shoots he traced down to cuts and bruises made by cartwheels in roots. "But," he writes,

"I could not say now if they were from roots of trees outside the road, or from roots of trees that were in the road and were cut out. The distance from the parent stem it is, therefore, impossible to give."

To ascertain whether these shoots were true suckers, or merely one of the many instances of ordinary shoots that spring up more or less in contact with the parent stool, the following experiments were tried:—

I. I had the soil dug up round eight trees, which I then cut down below the level of the ground. In two out of the eight cases, just enough of the stem was left to keep the principal roots connected. In the rest the stem was quite cut out, separating these roots entirely from each other; along with the stem a less or greater portion of the root was, of course, removed. The earth with chips of wood was then thrown back. All the trees were over 80 years old, three of them hollow and decaying.

II. I wounded the exposed portions of the principal roots of upwards of 100 trees. In some cases a chip of bark only was taken off with a sharp axe, in others a portion of wood also was removed; some of the wounds were made with a blunt instrument, others with a stone, and so on. A considerable number of the wounds were more or less covered over with fine earth, or ashes, or cow-dung.

III.—Similar wounds were made in the underground portions of many principal roots, and lightly covered over with soil.

IV.—And lastly, I dug up carefully the extremities of some principal roots and covered most of them up lightly with soil, leaving some in their natural position, others slightly bent upwards, to favour the production of suckers, if any were likely to come up.

Of the eight trees exploited underground, five threw up shoots the following rains, among these the two in which a portion of the stem was left. These latter, it must be noticed, produced the greatest number of shoots. In the three other successful instances the shoots sprang up from, or close to, the section of the roots; the three cases of failure were those in which the largest portions of the principal roots were cut away with the stem. Making allowance for differences of soil, the strongest shoots were produced by those which had lost the least portion of their principal roots. Experiments II, III and IV were complete failures; moreover, an inspection of over 5,000 stools coppiced did not show a single shoot that had not sprung up in contact with the stools. Besides this, on many occasions when I have met with young teak plants that, from their position to trees near them looked like suckers, I have had them carefully dug round, and have invariably found their roots entirely distinct from those of the suspected parent trees.

From the above facts the obvious conclusion is that teak is not disposed to throw up suckers. Had it possessed this tendency, in the first place a few out of the many cases examined would have presented shoots growing directly from a root; in the second place, experiments II, III and IV which put the roots in the most favourable conditions possible for throwing up suckers, would not have been all failures; and in the third place, the production, number and vigour of the shoots in experiment I would not have been in inverse proportion to the length of the principal roots removed in the exploitation and the cutting out of the stem.

It can, however, be urged on the other side, that in the three cases in which the stem was entirely removed, the roots *did* produce shoots. This fact is undeniable; but that these shoots are suckers is an entirely different question. To solve this question satisfactorily requires more extended experiment and observation, but in the face of the overwhelming negative evidence in favour of the conclusion drawn, and the fact that all the shoots in question sprang

up near the section of the roots, in other words, near their junction with the stem, I venture to offer the following explanation of this, in my opinion, only apparent anomaly.

The youngest seedling of deciduous, or broad-leaved species, possesses one or more buds just at the junction of the root and stem. In all, *Terminalia tomentosa*, teak and others, these buds are very large and conspicuous. It is these buds which develop into new stems if the original ones are killed by drought, fire, &c. As the young plant grows on, these buds, owing to want of sufficient light and to the sap being drawn up by the aerial portion, do not develop, but under the appellation of dormant or latent buds, continue alive, multiplying outwards dichotomously and more or less horizontally every year, so that their tips always remain just inside the outer bark. Now the lateral roots that are ultimately to become the principal roots of the future tree, make their appearance at almost the same level as these buds. As these roots increase in thickness by the addition of new layers of material, their upper surface obviously rises above the level of the buds, which can henceforward continue their growth only in the tissues of these roots. With most species, as with Terminalia, Hardwickia and others, this period appears to mark the death of the buds, and hence these species will then copse only when cut above the level of the roots. In teak, on the other hand, the buds continue to grow on with as much vigour as their fellow dormant buds in the stems of the tree. The common European oak, of which the *pedunculata* and *sessiliflora* are species, or, as some maintain, varieties, possesses this property in certain districts, as in the forest of Chantilly belonging to the Duc d'Aumâle. In most cases the roots arrest dead leaves, dust, &c., which cause the soil to rise round the foot of the tree and increase the depth of the dormant buds of the collum below the surface. If the soil from some cause or other is undergoing denudation, the buds, according to my theory, will generally remain above ground, and the tree will, in consequence, not coppice if cut *en terre*, as the French term it. My theory may be wholly wrong, but it appears to me to explain not only the case before us, but the exceedingly common occurrence of shoots which originate just below the surface of the soil but always in contact with, or close to, the parent stool or stem.

The question of whether teak throws up suckers or not has so important a bearing on the exploitation of coppices of that species, that I hope to be pardoned for having treated it at such length.

Teak coppice shoots the first year attain a height of from 3 to 12 feet according to the quantity of moisture in the soil; but under average conditions their height varies from 5 to 8 feet. By the second year they are from 6 to 18 feet high, the average being 8 to 13 feet, and so on up to the age of from 8 to 12 years when they measure from 30 to 50 feet. At this period they flower, and then the stem almost invariably ceases to increase in height. Nearly all the higher buds develop into inflorescences, so that a leading shoot can rarely be re-formed. This fact appears to be doubted by some, but it is too obvious to require demonstration.

Measurements on a large scale made in the Punasa reserve give for trees up to 30 years of age an average annual diametral increment of 0·28 inches. It is 0·30 inches up to 25 years, after which the growth gradually diminishes. I limited my countings to poles of 30 years, as it was impossible to find any tree above that age that had grown under fair conditions. Thus, poles with a girth near the base of 1 foot may be obtained in 14 years on an average. One pole 14 years old and growing in good soil measured 28 inches round at 3 feet above the ground. Some shoots, 5 years old (re-growth of exploitation 1871), have a girth of nearly 12 inches at 3 feet from the ground (average height 23 feet); others of exploitation 1874, not yet quite 2 years old, are already 18 feet high with a girth of from 6 to 7 inches. The average diametral growth per annum of the shoots of the former exploitation is 0·455 inches. These instances tend to shew that, with a proper method of cutting, and the exclusion of fires, it will require less than 14 years in Punasa to obtain an average girth near the base of 12 inches. I have unfortunately no exact figures for the other forests of the Central Provinces, but a few casual measurements I made in Kālibhīt, Khāmāpūr, Rājabūrārī Sāoligarh, and Borī shew a better growth for those reserves, as might be inferred from their superior rainfall and nearer proximity to the centre of the teak country. In Singrāmpūr, Messrs. Hooper and Moore have observed that—

"Under favourable conditions, the growth is rapid up to 15 or 20 years; at this period it commences to decrease, but still continues with a fair annual growth up to the age of 30 years, when the annual rings become very much smaller."

Their measurements give very nearly the same results as those described for Punasa. In the Satpura reserve, Mr. McKee believes that 20 years are necessary to grow poles of 12 inches girth, but I suspect that he examined poles that had grown under unfavourable conditions—repeated burning down and scorching by the annual forest fires, premature flowering, &c. Considering the geographical position and climate of that reserve, I feel justified in assuming that the rate of growth of teak in that reserve is little, if at all, inferior to that in Punasa. In Wardha, Mr. Smythies calculated 20 years to be more than sufficient to produce poles of 12 inches girth.

The table below gives a list of the useful or valuable species that are found associated in any quantity with teak; other species which, from their numbers, deserve mention are *Boswellia thurifera* and *Butea frondosa*. These latter exist in such abundance everywhere, and their present and prospective value is so small, that they must always be got rid of whenever any of the other species can take their places. Besides this, the *Butea* not only coppices more abundantly and vigorously than teak, but nearly two months earlier, and possesses a very heavy foliage—circumstances that are dangerous to the maintenance of teak. In Hathibari, a small forest

on the eastern limit of teak, a few sâl trees from 3 to 4 feet girth are met with in company with teak, "but", adds Captain Doveton, who is my informant, "I have not been able to account satisfactorily for their existence there." A true case of natural companionship of teak and sâl occurs in Motinala in Mandla, but even here they stand apart, the latter being found at the foot of the hill, and small teak on the hill a little higher up. In the table I have endeavoured to include such general facts regarding the species as are necessary to bear in mind when considering the best system for the management of mixed forests of teak and those species.

Systematic names of the species.	Where found in company with teak	Size they attain: Height	Size they attain: Girth	Partiality for light	Foliage: Crown	Foliage: Cover	Foliage: Season of year when leaves fall	Foliage: Season of year when new leaves come out	Reproduction: By seed	Reproduction: From the stool or roots	Rapidity of growth: Of seedlings	Rapidity of growth: Of stool shoots and suckers	Quality of the wood.	Girth at which the stool shoots and suckers attain an average market value	Age at which this girth is reached	Further Remarks
Lalbergia latifolia.	Rocky soils, slopes or uneven ground.	30′—70′	2′—6′	Hardy but forms leaf canopy well.	Rather spreading	Dense	Feb & Mar	May	abundant	Abundant and vigorous from stools up to at least 30 years	Moderate	Moderately rapid.	Strong very durable	18″	30	
Pterocarpus Marsupium.	Rocky soils, slopes tops of hills, and generally uneven ground.	40′—100′	4—8′	Very hardy but forms leaf canopy well.	Moderately spreading	Pretty dense	Apl.	June	Do		Slow	Pretty rapid	Rather inferior to preceding difficult to season.	1″—24″	20—40	
Anogeissus latifolia	All soils	30′—80′	3—5	Can stand almost any degree of exposure but grows well in the closest canopy		Ditto	Mar	Do	Do.	Freely from stool beyond 40 years.	Very slow	Rather slow	Hard, tough, strong liable to split.	18″	20	Excellent as fuel makes durable axles of cart wheels.
Diospyros Melanoxylon.	All soils where there is sufficien moisture	30′—70′	2′—6	Stands plenty of shade but is hardy enough.	Moderately spreading	Dense	Mar & Apl	May	Fairly abundant.	Freely from stool beyond 40 years, also produces suckers	Slow	A little quicker than dhaura.	Strong elastic	12″	20	
Terminalia tomentosa.	Wherever there is at least a moderate depth of soil and some moisture	60′—100′	4—7	Hardy but grows well in close canopy	Ditto ..	Very dense	Ditto	June	Exceedingly abundant	Coppices freely up to at least 30 years.	Rapid ...	Slow at first, rapid afterwards	Tough, strong bears tranverse strain well	24	30	
Ougeinia dalbergioides.	All soils, especially deserted fields.	15 —30′	1 —2′	Very partial to light	Narrow ..	Light	Feb	May ..	Abundant	Coppices almost indefinitely	Very slow	Very slow	Tough, hard close-grained.	18″	40	
Adina cordifolia Stephegyne parvifolia.	All soils containing a certain amount of moisture.	50′—100′	5′—8′	Can grow in close canopy	Very spreading	Very dense	Apl. & May	June	Fairly abundant under circumstances specially favourable	Coppices freely up to at least 60 years / Coppices freely up to at least 40 years.	Do.	Rapid ..	Soft, short-grained durable enough in the interior of houses.	30″	40	
												Pretty rapid	Better than preceding	36′	50	
Lagerstroemia parviflora.	Generally rocky or stony soils	30′—60′	2′—4	More partial to light than preceding	Moderately spreading	Pretty dense	Mar & Apl.	Do		Ditto.	Do	Rather rapid	Strong and durable enough	12′	15	
Acacia Catechu	All soils and situations, except very wet lands	20′—40′	1½ —3′	Exceedingly hardy and yet interlaces its branches with those of surrounding trees	Spreading	Dense	Mar ..	Apl & May	..	Coppices till a very advanced age	Rapid	Pretty rapid at first very slow afterwards	Hard, tough, very durable.	12″	20	
Schrebera swietenioides.	Stony soils	30′—70′	4—6	Partial to light	Rather spreading	Very dense	.. ..	Do	Fairly abundant	Coppices well up to 30 years	Do	Rather slow	Close-grained hard, but easily worked, durable			
Grewia tiliæfolia	Shallow and rocky soils	30 —40′	2′—5′	Hardy	Moderately spreading	Rather light	Mar	Apl.	Difficult	Ditto	Do		Expands with damp but strong and elastic.	12″	...	
Hardwickia binata	All soils with free drainage.	50′—100′	4—10′	Light loving but stands shade well during early years.	Spreading ..	Light ...	Ditto ..	May	Exceedingly abundant.	Coppices fairly well up to 30 years.	Slow	Slow ..	Hard dense, tough, strong, very heavy exceedingly durable.	24″	40	
Pendrocalamus strictus.	Stony or rocky soils with plenty of moisture, but free drainage.	20′—30′	2′—5′	Fond of shady places	Clumps spread outwards at top and form a dense shade				Do	Spreads by means of root stock	Produces only leaf bearing shoots for the first 3 or 4 years. The other kind of shoots attain their full length in a single season.					
Cmelina arborea	Uneven ground as a rule.	20′—60′	4—6	Partial to light but adapts itself to growth in leaf canopy	Pretty spreading	Rather dense	Feb & Apl	Apl. & May	Require specially favourable circumstances	Coppices freely up to at least 30 years.	Rapid	Rather rapid	Seasons easily, and is durable in the interior of houses.	4	30	Lasts better than teak under water

From what has been said regarding the size of the teak, it is evident that a regular supply of large logs cannot be expected—such would be the exceptional produce of our forests. But pieces of sufficient size will be obtained for all the ordinary wants of the population, from small rafters to beams and posts of 14 inches diameter, small boards, spokes and felloes of wheels, &c.

The present supply is notoriously under the demand. The principal large markets in the province for teak are Nāgpūr, Kamptee, Būrhānpūr, Khandwa, Khūmī, Mortaka, Jabalpur and Warora. Besides these and the smaller markets, large quantities of teak are bought up in the forest for export to Berar and Central India. The sales at Mortaka amount yearly to upwards of 100,000 poles of sizes, and would be much larger if more were brought into the market. The quantity taken to Khandwa probably exceeds the above figure, and Būrhānpūr and Khūmī scarcely receive less. Hence the total exports from the forest, both Government and private, cannot be put down at a lower figure than 800,000 poles and small logs, of which nearly 75 per cent. comes from private forests. But these are being rapidly and permanently exhausted as no forethought is given to reproduction. They cannot, therefore, be depended upon for a continuous supply for more than a short period, especially so in the western and some of the central districts; and very soon they will only be able to furnish small rafters. Knowing, then, as we do, that the actual supply is short of the demand, and that its present sources will fail at no distant date, we should be forgetting our duty if we did not endeavour our utmost to create a permanent balance between the two, consistently with the recognised principle that forests are equally the property of all generations. By this I do not mean that we should neglect the creation of a regular market for our other valuable woods, which are inferior only in comparison with teak. This end could be attained chiefly by fixing such a comparative scale of prices that common understanding will gradually see the expediency of using other woods where teak would be too expensive and another wood would answer equally well. It is, however, a mistake to suppose that the natives, at least those of the western districts and several others, such as Sāgar, Damoh and Wardhā, do not appreciate the value of other woods than teak; a casual visit to many native houses in towns and in the country proves at once the contrary. But when a native begins to build a house for himself, his first idea is durability, and indefinite durability if possible. Hence if he can get teak for nothing, or can afford to buy it and it exists in the market, he will get it, *coute qui coute*, just as in Europe a man under similar circumstances will prefer an oaken to a deal floor. Without attempting to forecast the future, it is not difficult to see that, with the extension of railways, cultivation, trade and other progress which results from a settled and civilised Government, while the other woods will come into general use, the demand for teak, especially of medium size, will be at least doubled. Hence our object should be to devise the most economical and expeditious means for turning out a present annual supply of at least 600,000 poles, and at the same time create a stock that will begin to yield double that quantity before the next 20 years. Are our forests at present in a condition to secure this object? I reply most emphatically, yes. My proposed teak reserve of 2,000 square miles, to judge from the outturn of exploitations in the western division, would contain 8,000 marketable teak poles of sizes to the square mile, besides the more promising ones that would be left standing with advantage. This, on a rotation of 20 years would give us a total of 800,000. The future doubled yield I expect—1*stly*, from the resulting coppice; 2*ndly*, from the coppice re-growth of stems that can never acquire any marketable value; 3*rdly*, from the development of existing young stock, and 4*thly* and lastly, from increased conservancy and protection and more rational treatment.

As is natural to expect in such a large extent of diversified country, prices vary considerably. At Kamptee, pieces 20 feet long and 1 foot 6 inches round in the middle fetch Rs 2 each, while poles of 12 inches girth sell at Rs. 60 per 100. Prices at Nagpur do not materially differ from the preceding. There second class logs find purchasers at from Rs. 2 to Rs. 2-12 per cubic foot. In the Wardha district, poles 12 inches in girth fetch Rs. 50 per 100 standing, the rates for larger pieces being proportionately higher. At Khandwa, first class logs (Barma timber) sell at Rs. 4 and even 5 per cubic foot; small beams of from 2 to 3 feet girth and roughly squared sell at from Rs. 2 to Rs. 3 each, and rafters at from Rs. 20 to 40 per 100. At Mortaka prices are about the same, but what is remarkable is that poles from 10 to 11 feet long, and from only 5 to 7½ inches girth, find purchasers at from Rs. 5 to Rs. 15 per 100. At Būrhānpūr, owing to its distance from teak tracts of any extent, rates are higher than at Khandwa. Taking into account all these different prices, and the necessity of works of communication to open out the forests, and making due allowance for a fall in rates consequent on an increased supply, it would not be over the mark to put down Rs. 8 as the average profit on 100 pieces of all the sizes actually obtainable from our forests: in other words, their average standing value. We have already seen that the annual yield will not be less than 800,000 pieces for the next 20 years; hence the net annual revenue from teak alone for the next 20 years would exceed Rs. 60,000. At the end of that time, with export roads established, the yield doubled, and prices enhanced, this figure would be at least tripled.

To sum up, we have seen—

(1.) That nearly all the Central Provinces' teak is small, attaining a maximum average height of 50 feet and girth of 4 feet.

(2.) That after careful selection we can obtain about 2,000 square miles of real teak-bearing forest.

(3.) That this area, generally speaking, is at present open jungle or interspersed with blanks of more or less considerable extent.

(4) That the major part of teak consists of badly grown coppice, the result of vicious felling, annual fires, total absence of improvement-cuttings, &c

(5) That as a consequence of (3) and (4), and owing to tall grass, dense shrub growth, &c, and also to the slow progress of seedlings during the first 6 years, natural reproduction by seed is very irregular, and cannot be relied on in the regeneration of the forests except to a limited extent, or where time is no consideration

(6) That teak coppices vigorously and abundantly till a very advanced age, and that, too, when cut below the level of the ground, the shoots attaining nearly their full growth in height (40—60') by the end of the 14th year

(7) That the present average rate of growth for the first 30 years is not less than 0·28 inches diameter per annum, 14 years being hence the longest period necessary for attaining good marketable size—just over 12 feet girth, also that this rate of growth will be appreciably higher with protection and treatment

(8.) That teak is associated in varying proportions with a number of useful, many of them very valuable trees, which are in large demand in the districts in which they grow, and nearly all of which are admirably adapted to form complete canopied forest with it, also that nearly all these trees attain a large size and are better suited for high forest, though they can grow well as coppice

(9) That the wants of the population are, and for generations to come will be, rafters, small posts and beams, that is to say, pieces from 9 inches to 4 inches in diameter

(10) That the present supply being, roughly speaking, 800,000 poles of sizes, the demand is considerably larger, and that as more than half this supply comes from private forests, in which nothing is done to keep up production, we must soon be prepared to meet nearly the whole demand

(11) That the 2,000 square miles in question contain enough material to yield 800,000 poles per annum if worked, with reference to teak, on a rotation of 20 years

(12) That with present prices and cost of labour, this quantity of poles would produce a net revenue of at least Rs 60,000 per annum for the first 20 years, besides securing us the inestimable advantage of opening up by means of good timber roads large tracts that are at present more or less inaccessible

The conclusion to draw from the foregoing data is that the whole area, divided into working circles of convenient size, should be worked on the system of coppice with standards, but with certain modifications, which will be explained lower down, the ultimate object being gradually to prepare the whole for conversion into regular high forest with natural reproduction Under the latter treatment the production will be larger, more varied, and of better quality, and the revenue much more considerable than in coppice with standards, moreover, the soil would be constantly protected and improved and the climate beneficially influenced We can proceed only by degrees, for immediate conversion would require such an excessive amount of artificial re-stocking, and hence heavy expenditure, with a distant prospect of return, that it cannot be thought of Besides this, coppice with standards properly carried out is the next best thing to high forest The advantages of the treatment proposed are numerous, but it will suffice to mention some of the principal ones—

(1) The present defective growth of teak will be replaced by straight, tall stems, springing up on a level with the ground, and all possessing their own roots and forming independent trees, the same is true of all the associated species, very old trees excluded

(2) These results will be obtained in a minimum of time.

(3) The coppicing operations themselves will materially induce a fuller and denser growth, so that artificial re-stocking need only be carried out on a small scale

(4) As a consequence of the above, the soil will be greatly improved after the exposed state in which it has so long lain

(5) Increase of foliage will increase the relative humidity of the air

(6) The country will benefit by an adequate and regular supply of the principal kinds of wood and timber in demand

(7) The revenue will receive a considerable addition from the very beginning, and will go on increasing as the forests are opened out and improved

(8) All these results will be obtained with a minimum of expenditure

(9) Hence it follows that if we regard the forests as a money investment, the accruing interest will be comparatively high, a consideration not to be entirely neglected in the present state of Indian finance

If teak has disappeared in some places (a statement open to question), or has been dangerously enfeebled by copsing, this result is not to be attributed to any inherent defect of coppice To use words in a precise way, the cause has been, not copsing, but pollarding Copsing replaces old trees by new stems which soon develope their own roots and enjoy an independent existence, whereas pollarding only hastens natural decay and death.

The working circles need not be small, for, as in the present state of our markets, we can cut out only certain kinds and classes of trees, the fellings will seldom, if ever, remove much material from any one spot, and hence there will be no disadvantage in having the area of the annual cuttings moderately large. Nor should the working circles be too large, otherwise both protection and treatment will be rendered difficult, if not impossible, and a convenient dis-

tribution of ages will not exist on the ground when the time for more regular working arrives. From 3,000 to 9,000 acres will, in my opinion, suffice for all present purposes.

It has been already stated that teak poles attain an assured and considerable market value as soon as they have attained a girth of 12 inches, and this occurs by the end of the 15th year at the latest. This determines the minimum rotation for teak. It remains to be seen whether it will suit the auxiliary species. Of these, the *Lagerstræmia parviflora* alone will be able to attain marketable size in fifteen years, but the *Acacia Catechu, Diospyros Melanoxylon, Anogeissus latifolia* will require twenty years, and the rest from thirty to forty, and even fifty years. It is needless to say that I omit all consideration of their value as fuel, a class of produce that is too abundant all over the country to possess more than a nominal money value in the forest. If the rotation were fixed to suit the last group of species, the produce derived from teak would consist chiefly of large poles 24 inches in girth more or less, and hence a considerable part of the demand for rafters would remain unprovided for. Besides this, the state of our timber markets is undergoing such rapid and organic changes, that it is impossible to foretell what modifications in working our teak jungles may be urgently required at the end of the next twenty years. If, then, we adopt long rotations, we may have to draw up fresh working plans on an entirely new basis long before the operations to be proposed which will aim essentially at improving the forests can pass through the whole area under treatment. In the third place, there is no present necessity for adopting a rotation to suit those species; the demand for them is not large enough to require their being worked regularly. For the above reasons, I would fix a limit of twenty years for the rotation. Rotations of from fifteen to twenty years would be convenient for the last group of species, as they could then be worked on the double rotation.

In the copsing operations we should have to cut—

(1.) All saplings, shoots or seedlings, to whatever species they belong, that are decaying, unhealthy, crooked, dwarfed—in a word, which time cannot convert into sound, well-shaped trees. This class will, of course, include all pollards.

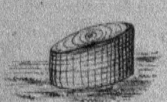
(2.) All decaying teak trees whatsoever.

(3.) All other decaying trees that are not wanted as seed-bearers and can yield sufficient produce to at least cover cost of cutting.

(4.) All trees and bushes of the worthless species (such as *Boswellia thurifera, Cochlospermium Gossypium, Zizyphus, Nyctanthes arbor ristis &c.*), that are in such close proximity to stools of the valuable species that they cannot but interfere the very first year with the production and growth of shoots on them.

Every other stick standing must be preserved. If we copsed regularly, leaving only the best trees for standards, we would be compelled to let three-fourths of the produce rot on and encumber the ground without the slightest compensating advantage. Besides this, one of our main objects must be to obtain a complete leaf canopy, and we cannot leave too many trees standing. In a word, copsing by selection on a large scale must be our stand-point: indeed, there is scarcely any other way of creating materials for a high forest.

The usual manner of cutting stools is too well known to require description here; still, as I have observed many forest officers speak only of sloping them in one direction, I may say a few words about a method followed in parts of the western division, which appears to me to be far superior to the preceding. The section is given the form of a low conical dome, so that the bark can be cut everywhere almost on a level with the ground, which is impossible with the other method. The axeman, standing on the side opposite to that where he wants to cut the stool, strikes very nearly tangentially and slightly inclined towards the centre of the stool. Thus the axe can never go off the wood against the ground, and the man can use all his force in striking. Three other advantages follow from this—rapidity, perfect adherence between the bark and wood, no chance whatever of the stool splitting. None but those who have actually cut a few stools with their own hands in both ways can appreciate fully the superiority of the one in question. All the shoots spring up on a level with the ground, which serves them as a firm *point d'appui* and provokes the early development of adventitious roots, the sole roots of the future tree.



The above should be the general method of cutting; but for large, old teak stumps, another method is necessary to prevent the otherwise inevitable formation of hollow, decayed butt ends. Experiments already described have shown that old teak will send up many and strong shoots when cut below the ground, and this even if the stem has been cut out, provided too large a portion of the principal roots has not been removed in this operation; also that these shoots, though differing little in size and vigour during the first year from the shoots produced on stools cut above ground (if there is any difference it is against them, as they have a smaller reserve store of food to draw from), these shoots, I say, begin to get ahead of the latter as early as the second or third year. The soil has to be dug up round the tree to be felled until the whole stem and principal roots are exposed. The stem should then be cut out as near as possible to its junction with those roots, and the earth thrown back and gently

pressed down. The section of the roots need not be as clean as that of aerial stools. The shoots that will spring up will possess the following advantages :—

I.—In shape and appearance they will in no way differ from seedlings.

II.—Their growth will be more rapid than that of aerial shoots, and much more so than that of seedlings.

III.—They will occupy more ground, *i. e.*, be further apart from each other, than aerial shoots, and thus aid powerfully in filling up spare growth.

IV.—They will probably flower later than aerial shoots, owing to their more vigorous growth—result, greater height of stem. I need scarcely observe that the use of the Indian carpenter's adze to shape the stools with is in every respect objectionable, takes too much time, and is much inferior to a well-shaped axe like that employed in Nimar.

I now come to what have been called improvement cuttings, *viz.*, cleanings and thinnings. In order to be explicit, it is necessary to define the ideas I attach to these words. By cleaning I wish to express the operation of setting free seedlings or shoots of the more valuable species which are interfered with in their growth by individuals of inferior species, whether this be done by cutting the latter down to the ground, or a certain height above the ground, or merely lopping off injurious branches, as the case may be; by thinning I mean the operation of removing dead, dying or overtopped and unhealthy trees, and also those which are on the point of being overtopped by others of more valuable species.

The cleanings should be commenced as soon as the struggle for existence begins among the individuals composing the crop. With teak the leader is always so much stronger than the side branches, that even when it is turned a good deal out of the vertical, it will still continue to form the axis of the tree, thus rendering it irremediably crooked. Hence the necessity of interfering early and frequently in the struggle. Cleaning should, therefore, be made the third or fourth year after the exploitation, and the operation repeated every third year until the twelfth or thirteenth year. Whatever is done, the leaf canopy should never be broken ; cut away only what is directly productive of harm. About the fifteenth or sixteenth year when the teak has nearly attained its full height, a thinning should be made, which, besides fulfilling the object of thinnings properly so called, should also do a little cleaning in the few places where it is required, and open out the dense crops sufficiently to favour the appearance and development of seedlings without admitting enough light to produce a close growth of stool shoots and weeds, such as *Mimosa rubicaulis, Nyctanthes arbor tristis.* It is superfluous to mention that all large and heavy species of creepers, such as *Bauhinia Vahlii, Combretum decandrum, Vitis latifolia, &c.*, in the cleaning operations must be got rid off.

The cleaning operations on the blanks and more or less large glades that may have been filled up either artificially or naturally will differ essentially from those already described, in that they cannot be performed at stated intervals. Coppice growth being certain and regular, the exact time when the more valuable species require cleaning round and over them, can always be foreseen with sufficient approximation for all practical purposes; but seedlings grow very slowly for several years, and where natural reproduction is given any scope (as it must be in the present case), they differ in age, size and vigour from point to point, hence the officer in charge will alone be in a position to judge the time when a cleaning becomes necessary. Moreover, the first thinning will not, as a rule, become practicable before the twentieth year, and then, too, there will be very little to distinguish it from a cleaning.

These are the regular operations; they do not exclude or do away with the necessity of constant *petits soins* on the part of the executive establishment. The foresters and guards must be directed to make a cleaning here, a thinning there, as the necessity arises during their daily rounds. After a short time, when they perceive the good results that follow from their work, it will become a labour of love, and inspection will then be required more to arrest misdirected zeal and set it on the right track.

Another operation which is for our present purposes as much an improvement operation as the two preceding is artificial sowing and planting. In our forests we have large blanks which it would take generations for nature to sow, also small glades which it is expedient to fill up at once; again, there are places where the crop, though comparatively full, now contains little or no teak, which, however, is adapted to the soil. In all these cases we must resort to artificial means. The most economical method would be to sow in cultivated parallel strips, where the slope, soil and standing crop admit of the use of the plough, and in squares regularly distanced where the soil is rocky, the crop deficient in teak, or a small glade exists. The parallel strips and squares need not be less than 12 feet apart. The intervals would fill up easily with *Terminalia tomentosa, Pterocarpus Marsupium*, and other species that germinate freely; indeed, the *Terminalia* seed might be scattered broad-cast on unprepared ground; moreover, a few teak seedlings could be transplanted between from the cultivated portions. The bulk of this artificial re-stocking need not keep pace with the coppice and cleaning and thinning. In each case the officer in charge would be able to judge what part should be done immediately, what gradually and slowly.

Pruning will be confined solely to the thin and weak lower branches of teak trees that promise to grow into timber; cutting them off close to the stem will cause only a small wound that will be covered over in a year or two; the advantage will be several feet of boles gained. But it would be a fault to carry this out too far, or, as the French say, *systématiquement.*

Before concluding it is necessary to say a few words respecting the direction in which the successive annual cuttings should follow each other; the size and weight of the leaves and

the thickness of pith in the stems are of themselves enough to cause the young shoots to bend down. This evil is aggravated by the violent winds that blow from the south-west during the rains Hence the cuttings should follow each other as nearly as possible from north-east to south-west, and on the south-west edge of each working circle a protective belt of trees should be preserved and felled by selection as they begin to decay.

Captain Doveton said that Mr. Fernandez had adverted to the uncertainty of the natural reproduction of teak, but his experience had been confined to certain forests where dense vegetation is opposed to the growth of young seedlings. In other parts of the Central Provinces excellent results had been obtained, notably in the Satpura Reserve, where a really good natural reproduction had been going on during the last three years, but then artificial aid had been given to the young seedlings in the shape of clearing away the grass around them. Regarding the rate of growth of seedlings, no natural seedling in the Central Provinces will attain a height of more than 6 inches in 2 years; in Jagmandal it took 7 or 8 years for a seedling to attain a height of 15 inches. Examinations he had made shewed that the rate of growth of teak coppice up to 15 inches girth would be 1 inch girth per annum, but the average rate of growth in the Central Provinces was probably much higher. Mr. Fernandez recommends coppice with standards as the best method of treatment. It must be remembered that we are dealing with one species only, and the coppice will be almost pure teak; in that case the effect of standards in the coppice would be highly injurious, and would materially decrease the yield of small wood.

Dr. Schlich gave it as his opinion, on which he did not invite discussion, that of all methods of treatment he considered that of coppice with standards to be the very worst. *Mr. Brandis* said that in India this method of treatment would in many cases be found necessary. In the north and centre of France immense areas of forest are treated on the system of coppice with standards by men who are thoroughly practical foresters, and who find it to pay extremely well. He thought that this method, with all its undoubted disadvantages, should not be absolutely condemned.

Mr. Wroughton inquired what time of year was best for cutting teak? It was better to cut in September, but the young shoots come up before Christmas and are cut off by the frost. *Mr. Shuttleworth* said that August was the best month for cutting teak, as the sap is then exhausted, and better wood resulted. But for the growth of the coppice shoots, it was better to cut in the hot weather before the rains; if cut after the rains, the young shoots do not grow well, and the second year's shoots are also less strong and vigorous. *Mr. Wroughton* remarked that it was also cheaper to cut in the hot weather, as labour was cheaper in that season. *Mr. Dunbar* said that when teak was cut in the hot weather, the poles seasoned in the ensuring monsoon; and *Mr. Oliphant's* experience corroborated Mr. Shuttleworth. *Mr. Gibson* said that the merchants always preferred to buy wood that had been cut in August and September, and that they made a distinction between spring-felled and autumn-felled wood; the merchants cut the wood in autumn, although labour is dearer at that season, for they know they can sell it at a higher price. *Captain Doveton* remarked that teak felled in the hot season was more liable to split; but merchants certainly did make a difference between timber felled at the two seasons.

Dr. Schlich said he had listened with great interest to Mr. Fernandez's paper. His experiments on copsing teak shewed a great amount of investigation into detail that was most necessary for the full determination of many important points.

Lac and its cultivation in the Central Provinces.

Mr. McKee then read a paper on "The Formation of Lac Preserves in the Central Provinces," which appeared in the January number of the "Indian Forester."

The Kham Tehsil System of collecting dues on Forest produce removed by Purchasers.

Mr. Greig read the following paper on the above subject :— Saturday, 9th October.

A short description of the North-Western Provinces Kham Tehsil system of collecting dues on Forest produce.

The forests, where this system is in force lie along the base of the Himalayas, and on the outer, or Sewalik ranges; all export is towards the plains, and therefore the southern is the only frontage that has to be watched; this frontage line commences at the Jumna on the west and ends at the Sarda on the east, a distance of about 200 miles. On the west of the Jumna is the Native State of Sirmoor, and on the east of the Sarda is Nepál.

On all the roads of any importance leading from the Government forests to the plains, toll-houses (chowkies) are established; most of these chowkies are placed as near to the southern forest boundary as possible; there are about sixty of them altogether; three or four are masonry huts, the remainder are temporary grass huts erected annually at a cost of about Rs. 3 each.

The establishment at each chowki consists of one mohurrir on from Rs. 10 to Rs. 16 a month, and from two to four burkundazes on Rs. 5 each.

At convenient places from 5 to 12 miles below that line there is another line of *purtál* (check) chowkies with an establishment of one mohurrir on Rs. 8 and one burkundaz on Rs. 5 at each.

There are also a Deputy Superintendent on Rs. 20 for about every 25 miles of lines, and a Superintendent on Rs. 50 for each Forest Division of, say, from 60 to 70 miles of lines.

Hitherto it has been the custom to allow any one to go into any portion of the forests between the Ganges and the Sarda, except the blocks of Sál forest that are closed for fire conservancy, and collect any forest produce except timber. The exporter takes his goods to one of the chowkies and then pays the authorised duty and gets a pass (*rawanna*) from the mohurrir in charge, in which is entered a detailed list of the articles and the amount of duty paid. At the purtál chowki his goods are checked, and if found correct, his rawanna is taken and a fresh pass given in exchange; in addition to this his goods are at any time liable to examination by the Superintendents or Deputy Superintendents.

Timber "removed by purchasers" is exported in the same way, except that only certain portions of the forests are opened annually, and with the exception of khair (*A. Catechu*) no trees are allowed to be felled. The export is confined to fallen trees and refuse from previous years fellings.

A list of the rates to be levied on timber and other minor forest produce during the following working season is circulated throughout the adjacent districts in August or September annually.

In the Dehra Dún Division—*i. e.*, between the Ganges and the Jumna—the system is different. Intending exporters apply to the Divisional Forest Office for any articles they wish to export; except in the case of head-loads of firewood and grass, payment is taken on issuing the permit, and in the permit is noted the amount of the articles, the amount of payment, the forest from which the articles are to be collected, and the chowki by which the goods will be passed out. A copy of the permit is sent to the mohurrir of that chowki; he weighs or measures the goods day by day as they pass out, and gives passes; he notes the export on the permit, and when the total amount has been exported, he returns it to the Divisional Office along with his monthly accounts.

In this division head-loads of grass and fuel are allowed to be exported by any one and from anywhere except from forests closed for fire conservancy. The exporters pass out by one of the chowkies and then pay the duty.

In the Dehra Dún Division attempts have been made to farm the minor produce on annual leases, but this has not succeeded well as yet.

The chowki burkundazes form a complete line of dák runners; by this dák the money is sent away daily either to the Divisional Office or to Tehsil Treasuries established for the purpose. At the end of every month the chowki mohurrirs submit their accounts to the Divisional Office; the accounts are then checked with the rawannas that have been returned from the purtál chowkies and are compared with tehsildar's treasurer's accounts of cash received. During the ensuing working season we intend trying the following plan in the Gurhwal Division, and if it proves a success, then it will be adopted in Kumaon and also, perhaps, in the Dehra Dún.

The forests of the Gurhwal Division cover about 600 square miles; of this area about 100 square miles of the best and most compact Sál forest will be set aside as a closed reserve and be treated accordingly, no exports being allowed except by special permission. The remaining 500 square miles of mixed forest will be divided into 20 blocks; during the working season of 1875-76 one of these blocks will be opened for the removal of all mature trees of all kinds above specified girths. A simple code of rules has been circulated, and under these rules any person may go into this block and fell and export timber. These rules provide against the felling of any but mature trees, against waste of timber by the too free use of the axe instead of the saw, and they fix the rates leviable on all classes of scantlings and logs. This one block only will be open for timber export, but the whole 20 blocks will be open for export of all other forest produce and bamboos. This is the arrangement for the first year. During

the second year the block that was open for timber export during the previous year will be entirely closed and protected from fire; a fresh block will be opened for timber export, and there will be 19 blocks open for export of minor produce and bamboos. This system will be carried on year by year. The sixth year 5 blocks will be closed; one block will be open for timber export as usual, and 15 blocks for minor produce and bamboos; the seventh year there will be one block open for timber, the 14 blocks that have not yet been closed will be open for minor produce and bamboos, and also the first of the blocks that was closed.

A summary of this system is— $\frac{1}{20}$of the mixed forests will always be open for export of timber by purchasers, and $\frac{1}{20}$ will always be open for export of minor produce and bamboos; timber will have a rest of 19 years, bamboos will have a rest of 4 years.

Captain Wood asked whether regeneration would have commenced in the first block before it was opened for the removal of produce? *Mr. Greig* replied that the system had been arranged in a suitable way to secure the reproduction. In answer to a question by *Mr. Pengelly*, he said that there was a large quantity of sâl, and the reproduction of this species was considered satisfactory. *Dr. Schlich* asked on what grounds the period had been fixed at 20 years? *Mr. Greig* said that the period was based on the ascertained rate of growth. *Captain Wood* remarked that this system would result in nothing but hollow sâl trees being left; but *Mr. Greig* replied that different rates were fixed for hollow trees, so as to encourage their removal;—and *Captain Campbell* stated that, in practice, old hollow trees were taken out. *Captain Campbell Walker* observed that in Madras the system was in vogue, except that the passes were issued by the Forest Department, and the money collected by the Revenue officers. *Mr. Hill* remarked that, by allowing contractors to fell indiscriminately, they would remove a great number of trees from a small area, causing blanks, and hence reproduction would not be good. *Mr. Greig* said that there was no danger of this occurring in Kumaon and Garhwâl as the valuable trees were all scattered. *Mr. Amery* asserted that the young crop existed already upon the ground, and all that was required for its development was the removal of the large trees and protection from fire. *Mr. Greig* further stated that the forests were divided into two classes, the first containing a good deal of sâl, the second containing little or none. The former class could be worked with a view to obtaining a fine sâl forest; in the latter, system must be sacrificed to revenue. *Mr. Hill* observed that if the regeneration of a forest was the first step to its improvement, then it was by no means assured by this system. *Mr. Shuttleworth* remarked that it was the duty of the Forest Department to improve all the forests under its charge in cases where the area was contracted.

Mr. Brandis said the chief matter for consideration was this: there are certain articles of forest produce which it does not pay to bring to depôt, such as dead wood and in some cases bamboos, and we must, therefore, choose between letting this produce decay or burn in the forest, and allowing it to be removed by licensees or permit-holders. In many forest tracts this system is a necessity, but it is equally essential that the reproduction of the forest should not be lost sight of, and nowhere is this more important than in the North-Western Provinces. During the past 12 years, the growing stock of bamboos in the outer hills of Garhwâl and Kumaon has utterly deteriorated, and unless early measures are taken, a scarcity of bamboos may be expected. There are certain valleys where good bamboos are still to be found, but these tracts are few and difficult of access. It is most important to find out how to combine this system of admitting purchasers to cut and remove certain classes of produce, with a good reproduction of the forest *Mr. Greig* responded that the revenue from bamboos was now greater than ever, and he received no complaints from the people of their deterioration. Along the roads, no doubt, they had deteriorated, but in the valleys he did not think they had done so. *Mr. Fernandez* enquired on what grounds a rest of four years had been fixed upon for bamboos? *Mr. Greig* replied that he had no data whatever. *Mr. McKee* said that his experience in the Satpura Reserve led him to believe that four years was amply sufficient. *Mr. Amery* stated that a certain rate was charged for mature trees, and that if trees of a smaller girth were removed, still the mature rate was charged; this restriction limited the removal of small trees. Operations were confined to one block of about 16 square miles, and the permanent establishment in charge of this would be one forest ranger and two guards, while the officer himself would be on the spot as much as possible.

Mr. Shuttleworth thought that this was not a sufficient supervision. *Mr. Wallinger* remarked that in the Poona district he worked departmentally, sales by auction were duly advertised, and in one case this year the amount realised reached thirteen times the expenditure incurred.

Dr. Schlich remarked that working by Government agency was certainly the most superior method, but unfortunately it was not always admissible, and as an instance he would mention Chittagong. The Chittagong hill forests are a non-regulation district extending over some 8,000 square miles, and inhabited by only about 80,000 people. Adjoining the district are Lushais and other troublesome tribes. The 80,000 British subjects have been accustomed to "joom" cultivation, and the Government will not admit, for political reasons, any interference with them except through the district authorities. Moreover, they have always derived part of their living by cutting and bringing out timber and other forest produce. Here it would be very difficult to introduce working by Government agency, and after five or six years' discussion, the following arrangement has been come to,—Close on 600 square miles of forests, situated in different parts of the district, have been set aside as Government reserves to be managed by the Forest Department free of all rights, the people who used to live in them having received compensation for moving elsewhere. All the remaining forests are under the sole control of the Deputy Commissioner, who allows the people to "joom" or cut and remove forest produce, either quite unfettered, or restricted by certain conditions. Within the district the people pay nothing for forest produce, but from all material taken beyond the boundary of the district into the adjoining Chittagong regulation district, revenue is collected in the shape of a toll. For this purpose a toll revenue station has been established on each of the twelve rivers which run from the hill tracts into the regulation district, on the boundary of the two districts.

There is one important difference between the North-Western Provinces' system and the Chittagong system. Whereas, in the former provinces the control is effected, in the first instance, by a staff of *subordinate* officers, it is done in Chittagong by *gazetted* officers only, and this he considered preferable to the former.

EMPLOYMENT OF SAW MACHINERY IN THE FORESTS.

Captain Campbell Walker then read his paper on "The introduction of saw machinery into our Indian Forests" as follows :—

The question of the introduction of saw machinery into our Indian forests, which the President has asked me to introduce, is one of great importance, and likely to attract more and more attention as the Department progresses and settles down, so to speak, to its purely professional duties, which, as has been very properly impressed upon us all by Mr. Brandis, consist in the production and bringing to market of the greatest quantity of forest produce compatible with the maintenance and improvement of our forest property.

In order that this produce, so far as it consists of timber, may realise the highest probable value, it is necessary that it should be brought to market in good condition and in scantlings most in demand, the worthless or unsaleable pieces being left in the forest. This can, as a rule, only be effected with a minimum of waste by the use of the saw, whether the "power" applied be mechanical or manual. The waste which occurs in reducing logs to a transportable and marketable size by the use of the obsolete native axes, or splitting into dockyard planks as has been the custom in the Anamallay teak forests of the Madras Presidency, is enormous. This is patent to all foresters and can be clearly demonstrated by a comparison of the cubical contents of a given number of trees as felled, and that brought to market and sold. Moreover, much that is brought to market depôts is unsound and unfit for use owing to heart-shake, hollowness, &c., a large proportion of the best part of the trees having been removed by squaring with the axe in order to reduce the stem to a portable size, and left in the forest in the shape of chips to feed the forest fires.

In my opinion, this question of conversion of our timber is most important and has been too much lost sight of at least on my side of India, where we find the rude native methods and implements still in use in all our Government forests. Dr. Cleghorn, "the father of forest conservancy in India," when Conservator of Forests in Madras, constantly impressed on forest officers the necessity of introducing improved methods of conversion by the use of the cross-cut and other saws, but little progress has been made in this direction owing to the *vis inertiæ* amongst the native employés, and to a certain extent to want of knowledge amongst our untrained officers of what is really required.

With the above remarks regarding the importance of the subject, I proceed to note briefly what has hitherto been effected in the direction of improved conversion by the introduction of saw machinery, premising that the idea of discussing the matter was brought to my notice too late to admit of my collating information for the compilation of a paper on it, and asking you to excuse any errors or omissions into which I may fall from want of knowledge and leisure to read up the subject and make myself thoroughly acquainted with what may have been done in the several provinces under the Government of India

I believe I am correct in relating that the saw plays a prominent part in conversion in the Government forests of British Burma, but I imagine that the saw-mills there are in the hands of private individuals Captain Stenhouse can probably tell us how this is.

The oldest established Government saw-mill of which I have heard is that at Ahiri in the Central Provinces, purchased and started, I believe, by Captain Doveton, on Colonel Pearson's suggestion, with the able assistance of Mr Thompson, who will read a paper on it

Captain Wood appears next to have taken up the subject and carefully studied it when at home on furlough, with the result that the Secretary of State authorised the purchase of a complete set of machinery and engines for use in the Oudh forests, the selection and entire management of which was entrusted to Captain Wood He selected Massey's double tension sawing machine, which he had seen at work on the Duke of Sutherland's property of Lilleshall near Newport, Salop, as that best adapted for his purpose, to be driven by a 12 H P ordinary portable engine, double cylinder, (Ransome, Sims, and Head), which drives also a circular saw and works a travelling crane for hauling in the logs, saw sharpener, &c This machinery is now at work at Suttiana in Oudh, and Captain Wood will, I hope, favour us with a few remarks on the results so far as can be judged from the short time it has been at work

Captain Wood's report, dated London, 1871, to the Under-Secretary of State, has been printed, and along with a memorandum by Major Meade, Royal Engineers, and other correspondence, forms a valuable contribution to our written information on the subject of saw machinery in India

These papers, along with my own reports and Mr Ransome's, are with me, and I shall be happy to lend them to any gentleman who may care to peruse them Captain Wood endeavoured to procure machinery, engine, boilers, &c, of a very portable description according to certain specifications of Mr Greig's, but this he found impossible owing to the great strength and weight requisite to withstand the motion and vibration in sawing our dense Indian woods, and it may be noted here as a fact that, so far as our knowledge and that of the best makers of machinery goes, it is impossible to procure extremely portable machinery fit to square and convert our heavy beams in the forests Captain Wood's main reasons for selecting Massey's tension sawing machine appear to have been that it obviates the difficulty and loss of power consequent on raising a heavy rectangular saw frame, and that the heavier parts of the framework of Massey's machine can be made on the spot of heavy timber But Captain Wood can explain the advantages claimed for this class of machinery better than I can.

The subject of saw machinery first attracted my special attention on visiting the Scotch forests of Lords Seafield and Mansfield and the Duke of Athol in 1871 In my reports on these forests, which have been printed, I gave some information and drawings of machinery which I had seen at work, and expressed an opinion that something should be done towards introducing saw machinery into some of our larger teak forests in the Madras Presidency. These remarks attracted the attention of Mr Brandis and Dr. Cleghorn, and we had several consultations on the subject at the India Office, where I had the pleasure of making Captain Wood's acquaintance and comparing notes with him. We fully agreed as to the advantages to be derived from a more extended use of the saw, and that machinery driven by steam or water power was preferable to hand-sawing, provided there was sufficient work to keep the machinery fully employed. The great difficulty which we foresaw, and which it has been the object of our experiments to overcome, is in obtaining a *special description of machinery adapted to our special requirements* This difficulty still remains, although I hope that the results of the introduction of the machinery into Oudh and North Kanara will do a great deal towards clearing the way to its successful solution.

The history of the North Kanara machinery to which I have just alluded is briefly as follows Captain Wood was first requested to report on the description best suited for those forests, and refers to the point in paragraph 26 of his report, but no further action was at that time taken by the Bombay Government, and it remained for Major Peyton, the Conservator of Forests, Southern Division, to take the matter up and to carry it through with the energy and zeal which so eminently characterise his administration This officer—whose absence from this conference (caused mainly, I believe, by his anxiety to turn out a good year's work from the saw machinery in North Kanara) must, I am sure, be greatly regretted by all who know him—had long felt the great difficulty of getting less big logs to market, and the great loss which took place in conversion He made some experiments with hand-sawing, and found that not only did he get enhanced prices for the timber so prepared, but that the sale of the outer slabs alone covered the expenses of sawing He therefore felt himself fully justified in urging on his Government the advisability of procuring and setting up saw machinery in the North Kanara forests, and after a perusal of my reports did me the honor of suggesting that I should be entrusted with the selection of the machinery, &c. The Bombay Government, placing implicit confidence in Major Peyton's judgment, addressed the Secretary of State accordingly, and he was pleased to concur, and I have every reason to hope from what I have heard from Major Peyton that the result will fully justify his expectations, and that to his exertions and the cordial support of the Bombay Government the Forest Department will be indebted

for the first successful introduction and working of steam saw machinery on a considerable scale in forests above ghâts

Major Peyton's first idea in the correspondence which took place between us, was to procure machinery so portable that it could be readily and frequently moved about in the forests. This I found impracticable, as Captain Wood had before owing to the great difference in sawing light pine wood with a maximum diameter of 18 inches, and enormous trunks of tough teak and blackwood of diameters up to 4 feet Mr Barrett, Deputy Conservator of Forests in Kanara, who was luckily at the time on leave, gave me, however, the useful information that very fair cart roads existed in the forests from the Hulial and Jelapûr depôts, and that it was customary to remove beams weighing 3 candies (15 cwts) with comparative ease Eventually I arrived at the following requirements —

(*a*) That the machinery should be capable of slabbing rough trunks up to 4 feet diameter, or of converting at least 100,000 cubic feet during a working season of say 200 days, equal to 500 cubic feet per diem.

(*b*). The engines and machinery to be moved to places where they are to work along roads, and not on men's backs, up jungle paths as proposed in the case of North-Western Provinces

(*c*) That it would not be necessary to move them oftener than once a year each way (*i e* from and to depôt).

Massey's machine I found unsuitable for several reasons given in detail in my report to the Secretary of State (paragraph 6)

It worked too slow to get through the work in North Kanara, taking 2 minutes to saw one foot of a 2 feet 6 inches log, so that with the double saw it would require 240 minutes or 4 hours to square two 30 feet logs, or if we allow for turning, &c, 5 hours, and would, therefore, only square four 30 feet logs in a working day of 10 hours. It required more excavation than I liked for machinery which was to be moved at least once a year, and, again, even supposing it as good or as well fitted for our purpose as machinery of another description, I thought it advisable to try another pattern, so that we might arrive at conclusions as to which was best. I therefore rejected Massey's machinery altogether, and after mature consideration and inspection of saw machinery at Home and on the Continent, and consultation with General Mackey, I decided on getting the engines from Ransome, Sims and Head, the well-known makers at Ipswich, and the machinery from Allan, Ransome and Company of Chelsea, who make its manufacture their speciality, and I eventually selected the following machinery —

1 Horizontal single blade saw frame for slabbing large logs up to 4 inches diameter.

1 Large rack circular saw bench to take saws up to 72 inches, and work up logs up to 2½ feet diameter

1 Small circular saw bench to take smaller pieces up to 1½ feet.

This machinery, to be driven by two of Ransome, Sims and Head's 10 H P economic expansive portable engines, is calculated to slab and convert 8 large logs of 4 feet, and 40 of 2 feet 9 inches diameter per day of 10 hours, besides small work to be performed by the small circular saw (Captain Wood's machinery, as has been already stated, is not calculated to convert more than 4 logs per day of 10 hours, besides small work)

Making liberal allowances for waste of time, meals, holidays, &c, I calculated that we might reckon on at least 20 logs per day, averaging at least 30 cubic feet each, or 600 cubic feet per diem, which for 200 days would give a minimum outturn of 120,000 cubic feet converted. It does not appear necessary nor does time permit to give any further explanation of the machinery which is still in a trial stage

My sudden recall to India in November 1873 rendered it impossible that I should inspect the machinery during construction and after it was finished, and bring it out to Bombay as originally intended, but those duties were performed as far as possible by Colonel Pearson and Mr Barrett, who suggested a brake to the engines, without which we would afterwards have experienced difficulty in getting them up-ghât

Mr Barrett was anxious to have the machinery put together and tested before leaving England, but Mr Ransome did not think it necessary and the Secretary of State would not sanction the expenditure which would have amounted to some £200 or £300 This is to be regretted as, owing to the unfortunate death of the Engineer in charge at Carwar shortly after landing, we were put to some inconvenience for want of knowledge of the several parts, fitting, &c, with which Mr. Barrett would otherwise have been thoroughly acquainted Some delay occurred in the shipment and trans-shipment in Bombay, but the whole machinery was safely landed at Carwar by Mr Barrett in December 1874, and by the end of that month all was up-ghât near Jelapur where Major Peyton had decided to commence operations The engines which are the heaviest part—weighing 5 tons each—were taken by Mr Barrett (whom I accompanied) from Carwar to Jelapur 60 miles up-ghât, in five days This was done by harnessing 8 pairs of buffaloes to each, but the chief credit for the speedy and satisfactory manner in which the journey was accomplished is due to Mr Barrett, who was indefatigable in his exertions We proceeded during the Christmas holidays to lay out the plan of shed, main shafting, &c, on the ground, which we were enabled to do before I left by the kind assistance of the range officer (Mr Whiteford) without which we should have done badly, the Engineer having as already stated died at Carwar from liver disease contracted before he came to India

For the progress beyond this I can only speak from what Major Peyton has written to me. There has been no hitch in putting up and working the machinery, part of which commenced work within one month of its being on the ground, the engines and the small circular saw have worked very well and given no trouble, with the larger saws of the rack bench

there has been some buckling, due probably to want of proper packing. This is what Colonel Pearson always feared, and I am glad to hear from Mr Thompson that he has now got a platform or carriage at Ahiri which reduces the tendency to buckle to a minimum

The horizontal machine was up and set to work more recently, but Major Peyton expresses himself highly pleased with it, he writes,—"It is a beautiful machine and works smoothly and well" He appears rather disappointed at its slow speed, 2 feet a minute, but it was never intended to saw quickly, that was left to the rack bench which ought to do 20 feet a minute with a 2 feet 6 inch log if required

The machinery is now in full work, and Major Peyton talks of writing for more in the shape of a vertical frame to cut up planking, as he cannot keep pace with the indents from Government Departments and the local demand. He finds, however, that it is not so portable as he could wish, but the next move will probably be much easier owing to greater knowledge of the machinery, and having the shafting, &c, all fitted. Major Peyton has dispensed with the services of the European sawyer and European engineer he got from Dharwar, and is working altogether with native employés, which he finds preferable, and writes that he gets more work out of the machines

Both he and Mr Barnett deserve the acknowledgment of Government and the department for their exertions and care to leave nothing undone calculated to make the experiment a success, and as I took the responsibility of selection, &c, I desire to tender them my best thanks. Neither pains nor money have been wanting to bring the matter to a successful issue The machinery cost in round figures £3,000 in England, including cost of hauling apparatus, saw-sharpener, engineer's lathe, smiths' and carpenters' tools, double-purchase crab, extra shafting and wearing parts, and a complete assortment of saws, &c, calculated to last for six years

Captain Wood's machinery, with one engine, cost £1,000, and would have cost in 1873 £1,200, owing to the rise in price of iron, &c I imagine, however, he had no spare saws, &c., included in the above. Mr Oliphant may be able to tell us the latest news of the North Kanara machinery, regarding which Major Peyton will submit a full report to his Government at the close of this official year

The Inspector General has asked my opinion as to the form in which the financial results and outturn of mills should be kept for purposes of comparison

Captain Wood and I agree that, for the present at least, the simplest plan is for the mill to debit itself with all timber handed over to it at local rates for unconverted logs, and take credit for the outturn, entering interest on original outlay, allowance for wear and tear, and costs of establishment employed on the debit side, and recording the number of working days and hours during each month or the working season. Simple forms for this can easily be drawn up by the officer in charge, comparison of which will give valuable information, and, I trust, lead eventually to private enterprise stepping in and buying or leasing our mills, taking over our timber in the forest or at the nearest depôt, and leaving us to produce and conserve it.

That this is no Utopian idea I think you will allow when I state that already in Madras a private firm is erecting saw mills at Coimbatore, and has taken the sawing of all our Anamallay teak on contract, and I am in correspondence with them regarding the introduction of saw machinery and taking over of all our timber in those forests

This was followed by *Mr. R. Thompson's* paper on "the working of steam saw machinery in the Ahiri forests, Southern Division, Central Provinces."

If I remember rightly, it was Colonel Pearson, Conservator of Forests, who first recommended the use of steam sawing machinery in the Ahiri forests for the purpose of converting the large amount of existing unsawn timber into railway sleepers. This was in the year 1868 In 1871 the demand for sleepers for the Wurdha Valley Coal State Railway was contemplated to the number of 60,000, to provide these, it was decided to supply them from the Ahiri forests, and to employ steam sawing machinery in their preparation

The machinery provided for this purpose, at the recommendation of the Public Works Department, Central Provinces, consisted of the following --

1 Large 30 inch timber frame.
1 Circular saw bench capable of working 40 inch diameter saws
2 Portable steam engines of 10 H P each

One engine and the timber frame were delivered by the Public Works Department to the Forest Department at Kamthi in March 1872; and by them it was conveyed to Ahiri The other engine and circular saw bench were sent up from the Godavery works by steamer and landed within five miles of Alapilly, the site of the present saw mills

On the 5th April the whole of this machinery was carried safely by the Forest Department to Alapilly and the work of erecting it, building-sheds &c, commenced Alapilly, as the site selected, was fixed upon on account of its vicinity, and otherwise favorable position as regards the forests from which the timber for conversion had to be brought On 23rd May following, all the machinery was in working order, and was fairly started.

It will not be out of place here just to say a few words about the position and the distance of Alapilly from the principal towns from which it is accessible Its general position with respect to these lies in a direction slightly south-easterly, the distance from each being —

From Kamthi to	Alapilly	181	miles
„ Nagpur	„	171	„
„ Wurdha	„	149	„
„ Chanda	„	75	„

The means of communication are, first, the great southern road from Kamthi to Chanda, part of which only is metalled and bridged, the remainder being an ordinary kutcha road. From Wurdha to Chanda there is scarcely a road worthy of the name, which, however, is in part made up by the recent extension of the railway to Hingunghât, a small town of rising importance situated about 51 miles north-west of Chanda. From Chanda to Alapilly a rough country cart track bears the name, and does the duty, of a road. Between Alapilly and Chanda lies the river Wyngunga or Pranheeta, a very violent and rapid stream during the rainy season, but which during the hot weather is fordable at almost all points. It will be seen from this brief description that the situation of the Ahiri Teak Forests from any town of importance is remote indeed; but we have now to look at the immediate surroundings of Ahiri, or Alapilly as it should be called, for it is here our seat of operations lies.

Ahiri is the name of the zemindari, and also of the chief village where resides the zemindar. The village consists of a collection of huts scarcely numbering 100; and the whole population of the zemindari, some 2,672 square miles in extent, averages but 8·7 souls to the square mile; and the cultivated area does not exceed 7,618 acres. Herein lies the chief difficulty the Forest Department has to contend with in the management and working of the forests; for not only is local labor scarce, but even the necessaries of life—the coarse food grains—are barely procurable at certain seasons of the year. Recourse has, therefore, been had to importing labor and food supplies at heavy cost to the Forest Department.

Coupled with these disadvantages is the impossibility of communicating with the railway at Wurdha and Hingunghât, or the town of Kamthi (where there is a Government workshop) within anything like a reasonable time in case of accidents or petty repairs being required to the machinery; for it must be obvious that, where a large band of skilled artizans and mechanics are employed, any break-down in the machinery, if not quickly repaired, must result in heavy loss accruing by the wages of an establishment forced into idleness. These considerations, therefore, led to the decision, that in order to work with machinery in the hope of profit, the appliances and necessary means for carrying out repairs and renewal of damaged parts must be provided for on the spot. A small workshop was therefore fitted up, and materials and tools provided in quantity sufficient to meet any emergency that should arise, except that from the bursting of a boiler!

A few words more before closing these introductory remarks. At the commencement of work with steam sawing machinery, European engine drivers were employed; but as it soon became evident that these men could not live in the forests, and that the expense of their maintenance during the idle season in the rains was far too heavy a drain on the funds at our disposal, it was agreed to get rid of them and employ native agency instead, and with this latter we have been fairly sucessful.

I will now proceed with a statement of the working of the machinery. I have already described what sort of machinery the Forest Department was supplied with, but I do not think I said anything about the working capacity of either the timber frame or the circular saw bench. I will now do so.

The timber frame is one built by S. W. Worsam & Company, Chelsea, and is constructed on a pattern which is obsolete at the present day with such machines. Mr. Worsam, junior, in a paper on mechanical saws, published in the Transactions of the Society of Engineers, London, 1867, calls it a "reciprocating saw frame" but both terms are, however, in use in the best books we have treating on the subject. The machine we have at present to deal with we shall continue to call the timber frame, and as such describe it. The theoretical power of this machine is, that it is capable of taking in a log of timber, either 30 inches square or 30 inches diameter. This is why it is called a 30 inch frame; though practically it is better adapted for sawing timber of less size, as will be shown hereafter.

The motive power to drive this machine with effect has been found to range from 8 to 12 horse-power according to the hardness or otherwise of the timber. With seasoned teak wood it has been found with 10 horse-power nominal to be only effective with diameters of 18 inches, and four saws working at 5 inches apart. For larger baulks of timber it has been necessary to reduce the number of saw blades (cutting at any one time) to 3, or even to 2, to enable the available steam-power to do its duty.

Mr. Worsam, junior, to whose paper previously quoted I am indebted for much practical information, has in an appended tabulated form given 8 H. P. as the average required to work the machine effectively, which, however, he somewhat qualifies by saying:

"In determining the power requisite to drive saw frames, we must be guided by the number of saws employed, and the character of the material under conversion."

Further:—

"the stroke of our timber frame is 22 inches, that is, the crank of the driving shaft has a radius of 11 inches, and consequently the frame to which the saws are suspended has an up-and-down movement of 22 inches either way. This is called the stroke of the frame."

Referring to what Mr. Worsam has to say on the subject of length of stroke, his words are:—

"The length of stroke is most effective, both as regards extent and quality of surface, when equal to depth of material sawn, because, on the complete ascension of the saws, all those teeth that were previously buried in the work are withdrawn, thus affording an opportunity for the sawdust to fall out and not choke them (the teeth).

"This rule, however," he further on says, "is not strictly observed in constructing large frames, except in cases where a constant standard of work is required, and though a frame may be calculated to take in a certain sized log, it is seldom called upon to fulfil its utmost duty, * * * and as increased length of stroke considerably adds to the dimensions and cost of the machine, any diminution in this respect must be viewed with favor by those interested."

This, then, is the reason why the timber frame the Forest Department is working at Alapilly, has only a 22-inch stroke with a capacity for taking in a log of 30 inches square; but this is not its most effective capacity as will be understood from what has just been said.

The length of stroke and size of the frame having been described, I have yet to show with what rate of traverse the cutting edges of mill saws are considered productive of the most useful effect.

I shall again appeal to Mr. Worsam's paper for this information. He says that "a rate of traverse of 225 feet per minute gives the most useful effective result." But how is this rate of traverse for each saw to be attained? I have shown that the length of stroke of the machine is 22 inches, or 1·83 feet; what number of beats must the machine then make in one minute in order to attain the full traverse of 225 feet? This is found by dividing the latter by the space moved in one stroke, *viz.*, 1·83 feet, the answer being 139·3 or say 140, which is the number of strokes the machine is required to make in one minute to produce the most effective result.

I will now describe the actual performances of the machine when driven at the velocity just stated.

In the case of ordinary logs of seasoned teak, which are easier to saw than when green, ranging from 16 to 18 inches diameter, the rate of cutting attained by each saw is 14 inches lineal measure per minute; or about 1·5 feet superficial. In the case of logs of less diameter, it has attained as much as 20 inches in the minute; but since the cutting speed is regulated by the size of the baulk, and the number of saws working through it at one time, any rate of work may be attained ranging between 6 and 20 inches per minute, that is, within the range of the feeding apparatus attached to the machine, power to drive, of course, being proportionate. Now, stating what in practice has been found the case whilst the machine has been in perfect order and well attended to, the average rate of sawing has been 150 running feet per hour registering the work of three saws only, no matter whether that number or more were actually employed.

In a working day of 20 hours (the working day at Alapilly) the average result derived from the registered measurements of work extending over 81 consecutive days, which include many interruptions, of course, caused by small accidents and wearing of parts, showed that the outturn was 2,389 running, or 3,119 superficial feet per day, or 117 running or 156 superficial feet per hour. Thus, by taking a large number of days, a fairly correct average has been deduced.

The cost at which this out-turn was secured, including the labour employed on the machine and the engine driving it, contingent expenses, supervising establishment and cost of maintenance of the forest workshop, was 14 annas per 100 running feet, or 11 annas and 3 pies per 100 superficial feet.

The capacity of a machine may be very great, and its out-turn of work be such as to fully realise the expectations formed of it; but there is another element which I must refer to, and which has everything to do with the successful working of machinery. I refer to the part the establishment working the machines can play as regards the total out-turn. In wood-working machines especially this may be said with more truth than with any other class of machinery that I am acquainted with. For with the former lie many opportunities of idling away time, which can scarcely be apparent till it is measured with results, and hence, the operators play a most important part as to whether the full out-turn shall be realised, or otherwise.

So intimately connected is this fact with the profitable working of machinery of the class we are obliged to employ, that I would lay the greatest stress on it, for, next to keeping the machines in order, the men who have the working of it must know the value of time and its consequent result. The labour employed must in all cases be skilled and to some degree also intelligent, not only where the handling of material to be wrought is concerned, but also in the direction of the means to effect it. The establishment must therefore be trained, and must know the value of time. To feed the machines promptly, to drive them so that the full effective power shall be brought to bear on the work in hand, are the important points that operators have to be trained to observe, and to which they should be compelled to adhere at any cost.

I shall now proceed to a description of the circular saw machine. I have already said that the one working at the forest mills at Ahiri is capable of running a 40 inch diameter saw. To drive such with full effect would require 18 or 20 horse-power; but as we have an engine of only 10 horse-power, the principal work done by the machine is confined to cutting down the sides and ends of 5 inch slabs, which are, in the first instance, prepared by the timber frame, and converting them into sleepers of 9′×10″×5″ scantling. If this machine were supplied with a sufficient quantity of such slabs, from 200 to 300 sleepers could be finished off by it in a working day of 20 hours; but the average quantity of work when fed by the timber frame, which must itself be in full working order to accomplish it, has been 200 sleepers per day. By the adaptation of a contrivance, known as the sliding table, for feeding the saw, great precision of work has been attained with this machine, as well as the out-turn of work being considerably increased by it. The sliding table referred to was designed and constructed at the forest workshop, and consists of a wooden table working on anti-friction rollers—the rectilinear advance against the working part of the saw being directed by guides—the power moving the table being the pushing force of two men against a cross-piece at the head of the table. A diminished necessary power to move the timber worked against, as well as to guide the cutting of the saw in a straight line, were the objects thus secured.

A circular saw bench, such as the Forest Department has at Alapilly, can be purchased for Rs. 1,500 to Rs. 2,000 when new, and the more improved patterns, with self-feeding movable tables, for about Rs. 3,000 each. But the initial cost of these machines, when the necessary power exists for driving them with effect, ought to be no objection to their general employment in forest mills where timber is being worked up. They are eminently useful, and do a large quantity of work in a very easy and inexpensive way. To construct such a machine as would work up to the standard of the most recent improvements, would not cost, if made up in the forests, more than Rs. 700 including the price of turned-steel spindle, bearings and cast-iron racks for mounting and running the table on.

Though Americans excel in the use of the circular saw in the conversion of timber, yet they scarcely ever think of employing any machines but such as can be constructed on the ground.

Instead of the solid heavy cast-iron benches, they use a frame or stand made of stout timbers firmly bolted to the joists and cross-pieces supporting the floor of the factory, the saw spindle and saws being purchased from the regular manufacturers.

Cast-iron benches have the advantage of durability, and are undoubtedly conducive to a more smooth action visible in the work turned out; but where the initial cost is heavy and cannot be met at the time, I would advocate the cheaper construction, rough and less durable as it is, as being capable of performing a large amount of useful work at the cost.

I have now to speak of an auxiliary machine belonging to a class which is akin to the circular saw machine, in that it requires to be worked at a high rotative speed to produce appreciable results, and it is of a kind that no saw mills should be without. I mean the saw-sharpening machine which does its work by the agency of a rapidly revolving emery disc driven by steam power. It grinds the teeth of saws down to the sharpening point, which without the inter-position of such a machine would have to be done with files and by hand at a much greater cost. Such a machine as I have endeavoured to describe here was purchased by the Forest Department, and cost, including a set of emery discs, about Rs. 600. It was soon, however, evident that at the rate we were working, one machine would not suffice for the sharpening of all the saws that had to be employed, and therefore two were necessary. A few figures will show this, especially if they are connected with what has been previously stated. Since the effective rate of traverse for the cutting-edge of a saw has been shown to be 255 feet in one minute, in one hour the space passed through would be 15,300 feet. This would represent in material sawn about 70 running feet, which in a shift of 5 hours would amount to 350 feet; but this quantity of work I must say is never actually done by one saw within that space of time, owing to delays in supplying fresh material, oiling of the machine and engine, and backing of the timber carriage which had carried the log forward through the frame. All these operations take up about 18 minutes of each hour, during which the saws are not working, the actual average performance per saw per hour being 50 running feet, or 250 such feet in the shift of 5 hours. After each shift, and before the succeeding one begins work, the saws are taken off the frame and sent to the saw-sharpeners to be sharpened and reset, a fresh set of saws being meanwhile attached to the timber frame.

The circular saw, too, does about 180 running feet per hour, but the material is invariably 5 inches thick, which gives a cutting speed of 900 running feet in the shift of 5 hours. Comparing this rate of work with that of the timber frame, we must remember that while the former cuts through timber of 5 inches thickness only, the latter has to cut through an average of 16 inches; and if gauged by this last standard, the average of work done by the circular saw would, in the 5 hours, be about 281 running feet only.

It will now be seen why two saw-sharpening machines were required. For saws have not only to be sharpened, but have also to be reset at the end of every shift; and this occurs four times during the course of 20 hours. This second machine was improvised at Alapilly, being built somewhat on the principle of the one we had purchased. Our material was wood, though the spindles and collars to run the emery discs on had to be made of steel; these the forest workshop turned out. When finished the new machine cost about Rs. 30, and is to this day to the front doing all the work required of it. As these machines are necessarily driven at a very high velocity in order to produce the grinding effect of the emery discs on the steel of the saws, recourse is had to steam as a motive power. We work both our machines off a single line of shafting made from a bar of round iron of 1½ inches diameter running in metal bearings. This shafting also was made on the premises, costing a little more than the price of the iron in Bombay and its carriage to Alapilly.

Excellent descriptions and drawings of the saw-sharpening machine will be found in Mr. Worsam's published papers on mechanical saws, a copy of which I now lay on the table for the inspection of those who care to refer to it. There is also another book, written by an American, called "the operator's hand book of wood-working machinery." These two works thoroughly illustrate and explain the mechanical contrivances employed at the present day in the conversion of timber.

I will now state what the actual working expenses of sawing by steam machinery are. The average cost per 100 running feet during a part of last working season was found not to exceed 14 annas, or 11 annas and 3 pies per 100 superficial feet for the timber frame, and 10 annas and 2 pies per 100 running feet for the circular saw. The cost of turning out a finished sleeper 9′ × 10″ × 5″ by machinery has been found to stand at 3 annas 10½ pies. This is the actual cost including establishments employed in working the machinery and attached to the forest workshop.

The following statement, drawn up at the suggestion of the Inspector General of Forests, however, gives the whole expenses with total out-turn during an entire working season.

I.—Statement of work done by saw mill.

1874-75.	Timber cut up.		Feet cut		Out-turn.			Current charges.		Remarks.
Month.	Logs.	Cubic feet.	Running.	Superficial	Kind and description of timber.	Number of pieces.	Cubic feet.	Rate per 100 cubic feet	Monthly totals.	
					Teak.			Rs A. P.	Rs.	
From 8th December 1874, to 15th July 1875. In all 32½ weeks.	11,697	134,226½	849,614	777,611	Sleepers ..	28,121	67,851	10 3 7	9,305	Average working time 15 hours. During the 32½ weeks, 30 days lost through repairs.
					Scantlings between 25 and 100 square inches cross section.	2,423	3,157			
					Total cubic feet	..	91,008			

II.—Detailed Statement of charges.

	Rs	A.	P.
1. Pay and allowances of Engineer (Native foremen)	392	3	4
2. Establishment employed on the machinery	2,671	13	1
3. Establishment employed on the timber	1,675	5	1
4. Fuel	175	11	5
5. Watering	204	0	11
6. Oil, grease, and stores for working	879	3	7
7. Repairs (including workshop establishment)...	1,197	0	7
8. Contingencies	76	8	1
9. Extraordinary charges	.....		
A. Total of current charges	7,271	14	1
B. Add cost of establishment maintained for the mill during the recess	500	0	0
C Add 10 per cent. of capital outlay on machinery	1,533	0	0
Total charges against the out-turn of the working season (91,008) cubic feet	9,305	0	0
Total charges per 100 cubic feet	10	3	7

It is just as well to state here, that these results were not attained at the very outset of our career with steam saws. Our efforts in the direction of economical working during the commencement was any thing but hopeful, for our knowledge and experience were next to nothing. A trip to Bombay, however, sanctioned by the Chief Commissioner of the Central Provinces, and an inspection of saw mills belonging to Messrs. W. Nicol and Co., soon showed how to manage our own. I date the success of the Alapilly mills from that time; for, previous to it, nobody on the establishment had ever seen saw mills at work. The European drivers could give no help, for they know nothing beyond driving their engines. From the commencement of the working season of 1872-73 the mills began to show a fair out-turn of work, which has since gone on improving as the establishment gained skill and experience in working up to the full powers of which the machinery was capable.

A short comparison of costs between hand-sawing and sawing by machinery will not stand out of place here. We will suppose that hand-sawing was the agency going to be employed in making sleepers in the Ahiri forests, and not machinery. I do not think I over-state the case at all when I say the necessary amount of labour could not have been procured in the Central Provinces; and if imported, the probabilities are, some of the men would have sickened and died, and the rest would have then run away. The cost of bringing this labour together and feeding the men till their arrival in the forests would be great, as I doubt if they could have been got to come for less hire than one rupee per sleeper. We will, however, assume that we got the work done for less, say at 12 annas per sleeper, which would be about at the rate of Rs. 3 per 100 running feet of sawing; the charge per 100 sleepers would then have stood:—

	Rs.	A.	P.
Felling and logging 8·3 tons of timber, at 10 annas per ton of 50 cubic feet	5	2	5
Carriage to depôt of 100 prepared sleepers, at 3 annas each . .	18	12	0
Sawing 100 sleepers by hand, at 12 annas each	75	0	0
Total	98	14	5

or, say 1 rupee per sleeper. The solid contents of such a sleeper would be 3·124 cubic feet; and allowing one-third of the material felled and logged to be unproductive, we should require about 417 cubic feet for every 100 sleepers. Of course, I here assume that the felled timber is sound; for if hollow, the waste would be much greater. I have seen it range as high as 150 per cent. Where such material as this has to be cut up into pieces of a fixed size, the expense

of sawing is also necessarily increased. However, I will turn to the price at which 100 sleepers precisely similar could be turned out by machinery :—

	Rs.	A	P.
For felling and logging 8·3 tons, at 10 annas per ton	5	2	5
Carriage to mills of above, at 1 anna per cubic foot, or Rs. 3-2-0 per ton	26	1	0
Sawing by machinery, at 4 annas each	25	0	0
TOTAL	56	3	5

as against Rs. 98-14-5. Saw machinery may give unfavorable returns when unsound timber has to be converted, for then a larger amount of unproductive material has to be collected and brought to the mills, whilst there is also a waste of sawing power in the conversion.

Now, as regards the suitability of machinery for forest work, I think it must entirely depend upon circumstances, such as the situation of the forests, the material to be worked up, the ruling price of labour, &c., in their vicinity. When the rough timber can be felled, collected and brought to a central depôt, where alone saw-mills ought to be erected, at a cost which will not be in excess of that for which it could be converted by hand sawing on the spot where it was produced, or when the carriage of such timber in bulk to a market is impracticable, then, under those circumstances, the use of machinery for the purpose of conversion is sanctioned by every consideration.

Moreover, for general work where there is a demand for sawn timber of various dimensions, and not of one uniform size, as is the case with railway sleepers, in fact, where no waste of the rough material is possible, where every cubic foot brought to the mills can be utilised, the advantages of having machinery are unquestionable, both as regards economy of timber and the price of its conversion.

Hitherto, with the Government saw-mills worked by the Forest Department, the case has been very different, and since it is a subject which must have frequently occurred to most forest officers who have had to do with the supplying of sleepers for railway purposes, I make no further apology for introducing it in this paper. I mean the folly of calling upon the Forest Department to supply sleepers for railways, while the rest of the wood material required for the lines is allowed to be purchased from elsewhere by the Railway authorities.

In the conversion of our timber into sleepers there necessarily must be hundreds and thousands of pieces of good sound timber capable of being cut into posts, rafters, battens and planking, but which from size and shape are, perhaps, unfit for sleepers. Now if, with the order for the supply of the sleepers, there was also sent an indent showing the total quantity, with specifications, of all other timber required for the line, including railway keys, we should, whilst supplying the former, be in a position to utilise a great deal of the material which, under existing circumstances, has either to be left in the forest, or laid aside at the mills as being unfit for sleepers. The fact is, the economically working up of the products of our forests demands that there shall be no waste; but so long as the present system is permitted, so long there will be waste. We cannot force this timber into the market; it may, or may not, sell there; but if sawn up to specifications for the railway, the matter of its disposal is at once settled. I am sure this subject requires the best attention of forest officers, for on a proper settlement of it will greatly depend what I cannot but apprehend ought to be the case, *viz.*, the largely increased use of machinery for the conversion of wood. I hope to see the day not far distant when machinery will play an important part in Indian forest management.

Now, as to the class of machinery giving most useful results in the conversion of timber, I should certainly say none surpass the performances of those in use at the present day, *viz.*, the circular saw and timber frame. Were I to have the planning of a forest saw-mill and recommending of machinery best adapted, I should recommend two timber frames of 30 and 24 inch gauges, and one circular saw bench capable of working 60-inch saws. The bench I would construct myself, only purchasing the saws, spindle and rack for mounting the running feed table on.

Emery discs and vices for the saw-sharpening machines would also have to be purchased, the bodies of the machines being constructed of wood on the spot. A supply of material and tools for repairing damages, a small lathe, and a suitable establishment of native artizans would also have to be provided.

The driving power I should advocate, would consist of two portable 20 horse-power engines, by Clayton and Shuttleworth, supplied with clutch and universal joint so as to be driven together, the power being communicated by them to the machinery through shafting.

With these engines the timber frames could be worked at 15 and 10 horse-power respectively, whilst the circular saw would consume about 15 horse-power nominal. The lathe and saw-sharpening machines, requiring very little driving power, could always be supplied from the actual surplus over and above what I have named as the requirements of the wood-working machinery which has been liberally calculated.

It is safer to err rather on the side of excess than having too little power wherewith to do the work. In the Himalaya, water-power is available to a very great extent, and at every degree of necessary fall; sawing machinery, therefore, of the most powerful description, and costing when in actual work the merest trifle, could be erected, I should think, at less than half the price now paid for machinery driven by steam.

Captain Wood then described the steam saw-mill at Suttiana in Oudh.

Mr. Molesworth then made some remarks on the financial results of conversion of wood by machinery. Seventeen years ago, he had read a paper at the

Institution of Civil Engineers shewing the difficulties which militated against the introduction of machinery in converting wood, such as wear and tear, interest on the capital, adjustment of work, stoppages, loss of timber, &c. He would now read an extract from a book written by an American manufacturer of wood-working machinery, a man not likely to be prejudiced against machinery of this description. This referred to conversion of wood *generally*, moulding, planing, &c., not to sawing only.

"There is perhaps nothing in manufacturing that so often leads to mistakes as the want of a true estimate of the saving effect of machines. It is a most natural thing to estimate the labour-saving of a machine as the difference between what it will produce with an operator, and what an operator can produce without a machine, an estimate that is altogether wrong and unsafe. Without following out the various questions that enter into the relative cost of performing a certain work in the two ways by computing repairs, investment, power, room, insurance, rest, danger, &c., we have only to turn to that practical and certain test, the past history of hand and power performance" * * * * * *

"To go to facts, we shall find in England and in North America that the general saving effected by machinery in this class of manufacture does not exceed 15 per cent. in its cost, and is much nearer 10 per cent., as an average; it is even so little that in some instances we yet find hand labour competing in the manufacture of chairs and tables, and were it not for the division of labour carried out by the exclusive operation of the manufacturers when machinery is employed, the difference would be still less."

"From these things a tolerably correct idea can be formed of the influence or gain of the machines when applied to the operations in general, and how likely we are to mistake the value of machinery when considered with reference to special operations unless we have some rules to guide us in contrasting hand and machine performance."

In some cases labour is not obtainable, and here it would be necessary to employ machinery, but its financial success is not always so great as is generally supposed. For example, in brickmaking by machinery, where every thing appears to be simple, and the bricks are turned out at a great rate, hand labour has been found to compete successfully with it. In the case of forests where heavy wood has to be moved up to the machinery without good means of transport, the cost of carriage will eat up the profits due to rapidity of work. The circular saw is very useful for small wood; but in large work the friction of the large revolving surface causes great consumption of power, the saw is apt to buckle, and its high velocity causes great friction. The double tension saw has some advantages for single cuts; it is more easily counterbalanced than a reciprocating machine. The band saw would probably be ultimately used for large timber, but as yet it has not been sufficiently perfected. It has many advantages over other kinds of saws: great velocity, not much friction, and less tension than the reciprocating saw. One objection against it is that the blades are apt to break; but a manufacturer had told him that supposing the breakages were five times as frequent, it would still pay to use the band saw. It was also rather difficult to back-up and lubricate, but these disadvantages would probably disappear in course of time. In forests where skilled labour and supervision are hard to obtain, it is very difficult to introduce what would be theoretically the more perfect machine for working.

Dr. Schlich said that there are circumstances where saw machinery, whether moved by steam or by water, may be useful, but we should never forget how little saving there really is. A great difficulty consisted in the unhealthiness of the forest, where the falling sick of one individual frequently stops all the work. He was very much obliged to Mr. Molesworth for preventing steam saw machinery from becoming a hobby of the Forest Department.

Mr. Brandis remarked that there were two essential conditions for the successful introduction of saw machinery into our forests, 1*st* the forest must contain mature timber in compact masses, *i. e.*, not scattered about; 2ndly hand labour must be uncertain, or else very expensive. Under these circumstances machine labour may become a necessity. We must now endeavour to collect precise returns of the work done by the three existing sets of saw machinery, *viz.*, those at Alapilly, in Kanara, and in Oudh. These returns will hereafter enable us to say whether saw machinery should be resorted to more extensively in our Indian forests, or not. But looking at the subject broadly, he agreed with Dr. Schlich that in most Indian forests saw machinery would not pay. In one way, however, unhealthiness is in favour of machinery, as sawyers often bolt in hundreds at the appearance of fever or cholera. In conclusion he thanked Mr. Molesworth for preventing our taking too sanguine

a view of the advantages to be derived from introducing saw machinery into our forests.

Mr. Shuttleworth then communicated the following remarks on steam saw machinery in the Bombay Presidency :—

In Bombay, Messrs. Nicol and Co. have steam saw machinery at Tank Bunder which supplies almost all the sawn timber required in the northern districts of Bombay by the Public Works and other Departments of Government as well as by Native States and private building enterprise. The wood chiefly in demand is teak, a great portion of which is obtained from Burma. Intending builders send to Messrs. Nicol and Co. indents with specifications of the wood they require, which is sawn up to the sizes indicated, and supplied; it is, therefore, manifestly more to their advantage to go to Messrs. Nicol and Co., to obtain the wood they require ready sawn up and fitted to the sizes suited to their wants than to have recourse to the Forest Department for timber in rough, having to saw it up by hand. With this fact before him, and the Forest Department having at command a large tract of forest in the northern portion of the Presidency, the Dangs, situated within 40 miles of the Bombay, Baroda and Central India Railway, and containing very large teak and other timber fully capable of supplying all the wants of the adjoining Collectorates and Native States, the Conservator of Forests was fully justified in recommending to Government the purchase of steam saw machinery for the Dangs. Government fully approved of the proposal and an indent was preferred on the Secretary of State for India for steam saw machinery exactly similar to that provided for North Kanara and selected by Captain Campbell Walker. But nothing has been heard of the fate of this indent. The saw machinery asked for has not yet appeared. Another benefit in addition to supplying the demands of sawn timber for proposed buildings, anticipated by the introduction of steam saw machinery into the Dang forests, is the saving in wood for the above Ghât trade. At present all logs taken up the Ghâts, which are from 1,500 to 2,000 feet high, have to be dragged by cattle, and as small sized logs only can be so dragged, it follows that, of large trees, only a small portion of the timber is taken into the market and pays its value to Government; the remainder of the wood is wasted in the shape of chips that are axed off the natural log to make the timber portable.

The Dangs are not only notoriously unhealthy, but very sparsely populated, and for these reasons it is extremely difficult to obtain the services of sawyers.

Mr. Fernandez communicated the following extract from the "Revue des Eaux et Forêts."

Mr. George Robinson of New York, has invented a new and most remarkable method of sawing. A platinum wire raised to a white heat by an electric current takes the place of the saw, and is worked to and fro in precisely the same manner as a tension saw. The rapidity with which the wire passes through the hardest wood is something incredible. According to the inventor, planks and scantlings of all sizes can be turned out, and, as the wire is thin, all kinds of curves can be cut with it. The surface cut by the wire is, of course, carbonised, but this carbonisation is entirely superficial.

The Municipal Forests of Simla.

Mr. Vincent then read the following paper on the above subject:—

The sanatarium was first established in 1830, the land belonging to the States of Puttiala and Keuntal being exchanged with the British Government As part of this arrangement, 17 villages belonging to the Keuntal Chief were transferred to the British Government. The present sanatarium occupies the site of these villages. Until the year 1858, nothing remarkable appears to have occurred in connection with these forests.

They remained under the charge of the Deputy Commissioner, Simla. The inhabitants of the surrounding villages and the Simla community were allowed to cut grass and firewood free. In 1855 the municipal committee was established, and in 1859 the Commissioner vested the municipal board with full authority over all the woods and forests on the Simla Hill, remarking that the village boundaries were merged in those of the station, and deprecating the concession of a right to fell timber to either Natives or Europeans. Up to 1859, the villagers had made no claim to the proprietorship of the lands surrounding these villages, and the only prescriptive rights to which they laid claim were those of cutting grass and firewood and timber for domestic and agricultural purposes.

In this year, however, one Nath, a zemindar, leased some land surrounding his cultivation on a perpetual building lease. The right of Nath over this land was disputed, but the Deputy

Commissioner declared the lease to be legal by deciding each village to be entitled to a certain amount of pasture, grass and jungle land, in proportion to its cultivation. About this time several gentlemen became proprietors of villages, and by virtue of what they afterwards considered proprietary rights, they felled the trees in the adjoining forests. At the time, however, they obtained by payment permission from the municipal committee to fell these trees, and only commenced felling them after having obtained such permission. Of course, if each of the 17 villages on the Simla Hill had rights to an amount of forest land surrounding its cultivation, and could exercise complete control over these forest lands, the probable result would be that Simla would soon become a bare tract destitute of trees. The claim to forest lands was the more uncalled for and unsupported, as many of these villages owed their prosperity or their very existence to the establishment of the sanatarium. Up till 1855 sites for houses continued to be given away by the Deputy Commissioner. Since that time it has been the practice only to sell waste land, not to give building sites on forest lands except in special cases, as it has been proposed to reserve all the remaining forests.

In 1870 an officer (Mr. A E. Wild, of the Punjab Forset Department) was sent to draw up a working plan for the Simla forests. This was commenced, but owing to the weighty point whether the Deputy Commissioner's decision, giving proprietary rights in adjoining forest lands to village holders was to stand, no proper and definite plan of operations could be brought out. The actual boundaries of the forest were undefined. If this decision was confirmed, the forest remaining to the municipal board would have been so inconsiderable, that it would have been scarcely worth while entering into a scheme of management involving any large outlay. One of the proprietors had already exercised his right in virtue of the decision and had cleared whole hill sides of timber. Further devastations were stopped by an injunction to refrain from taking possession until further notice.

Since Mr. Wild wrote his report, the municipal boundaries have been laid down and defined and the greater part of the forest which you see on the Simla ridges may be regarded as the property of the municipality. It is now proposed to have a proper plan of operations for the next 5 years, and, in order that this plan may be completely and thoroughly carried out, the municipal board intend applying to Government for a trained European forest ranger on Rs. 150 a month to take charge of its forests. The reasons given for this step are to increase the revenue of the municipal board by cutting of timber, and by replacing the unremunerative oak and rhododendron by deodar, to provide against the erosion of the hill sides, to improve the landscape, and lastly, to gain better ventilation by judicious thinnings, of which some parts of the forest are in great want. During the rains some parts of the station are very stuffy and close. At the present time no regular fellings or thinnings are being carried on; only single trees are cut where they are in the way, or too old to stand. Although the wood situated in compounds of the various houses belongs to the house owners, no trees can be felled within the municipal limits without express permission of the municipal committee.

Mr. Wild's report having only gone so far as to divide the forest into blocks, I cannot give you much information as to the works which will be carried out during the next five years. The blocks are sixteen in number, all have natural boundaries. The first and only thing that has as yet been proposed is to thin blocks Nos. 1 and 15, and make a trial planting of deodar in block No. 16. Block No. 1 is north of Prospect Hill; No. 15 is the deodar forest lying below Benmore; and No. 16 is the land lying to the north of No. 15 towards the Barra Simla Bazar.

The chief trees found in these forests are—

Quercus dilatata.	Pyrus variolosa.
Quercus incana.	Cedrus deodara.
Rhododendron arboreum	Pinus longifolia.
Ilex dipyrena.	Pinus excelsa.

Abies Smithiana.

Colonel MacMahon remarked that no trees were felled now within the municipal limits, and that no proprietor can cut trees even on his own estate without previously obtaining leave from the municipality. *Dr. Schlich* objected to the contemplated replacing of oak and rhododendron by deodar; it was difficult to obtain a good supply of water for Simla, and, therefore, above the level of the church, he would rather interplant oak and rhododendron than cut these trees down. *Mr. Brandis* said that when he first came to Simla in 1863, the western side of Jakko and other slopes were covered with oak and rhododendron, under which species the soil remains more moist and forms a good bed for deodar; in consequence, the deodar had encroached and nothing would be easier than to encourage this; but it would be a great pity to get rid of the oak altogether. The ultimate plan for a portion of these Simla slopes would, probably, be a mixed forest of oak and deodar.

The Impregnation of Wood.

A paper on the above subject by *Dr. Warth* which will appear in an early number of the "Indian Forester" was then read to the conference by *Mr. Hill.*

Forest Maps.

The fifth day's proceedings were commenced with *Captain Bailey's* paper on "Forest Maps" as follows:— **Monday, 11th October.**

When I first undertook my present duties, a great doubt existed as to the requirements of forest maps in India.

Colonel Pearson, at that time officiating as Inspector-General of Forests, consulted a number of officers of the Forest Department on this subject, and their replies led me to suppose that maps on a very large scale, showing the topography with minute accuracy, would be required.

I however obtained permission to commence work on the scale of 4″ = 1 mile in Dehra Dún, North-Western Provinces, and I now exhibit three sheets of the map in which all the detail the scale admits of has been shown. These sheets are based on data furnished by the Superintendent of the Great Trigonometrical Survey, and are constructed on the same system, and with the same attention to accuracy of detail, as those issued by the Survey Department.

One copy of each sheet is purely a topographical map; but on the other copy some information regarding forest growth has been recorded. Washes of colour have been used to indicate the different kinds of trees, and numbers 1, 2, & 3, to show various degrees in the density of the crop.

To survey in this way the whole of the forests under the control of the Government of India would, with my small establishment, take a great number of years; but I hope to be able, in a manner hereafter to be described, to reduce the amount of labour in surveying topographical details, and to obtain such assistance from the Conservators of Provinces as will greatly expedite the work in hand.

The Government of India has sanctioned a proposal to send young officers from the provinces under its immediate control to go through a course of instruction under me. The first of these officers, Mr. O. Greig of the North-Western Provinces, has been at work for about six weeks, and others are shortly expected. These officers will, on completion of their course, return to their own provinces, there to work under the Conservators, and will receive professional advice and assistance from myself. In this manner I hope that systematic work may shortly be commenced in all provinces.

I have no doubt whatever that the first things we require are good sketch maps. These, if carefully made, will in many cases answer the requirements of the department for some time to come; and whenever a more accurate and detailed survey has to be made, they will prove of the greatest assistance. I would instance the maps being prepared under the orders of Dr. Schlich, Conservator of Bengal. These are, I understand, partly compiled from existing maps, and added to by rough surveying and sketching. I think that the value of such maps for present purposes, and as a guide to the execution of subsequent and more accurate surveys, can hardly be over-estimated; but I wish it to be distinctly understood that such sketch maps as I have above alluded to cannot be considered as final works; they must precede the better class of surveys, which I propose presently to discuss, but cannot be substituted for them.

As a larger extent of forest area is brought under systematic management, a better class of maps will certainly be required; and I hope to be able to construct them partly by the aid of my own officers, and partly by that of the officers who will have returned to their own provinces after going through a course of instruction. These officers will, at any rate, make all the sketch maps which may be required.

The question of whether such detailed maps as those now made of the Dehra Dún are a necessity I shall go into further on, and I shall be very glad of the opinion of the officers present on this subject. We have, I think, at any rate shown that we can make good topographical maps, and if Conservators are of opinion that less detail will serve their requirements, I shall be most happy to reduce the amount; but I wish to insist that, however much my work may be reduced to a skeleton form, the skeleton or framework should, for the better class of maps, be accurately laid down, so that they may be capable of completion at any future time.

With a view to the collection of information regarding the system of forest mapping pursued in France and Germany, I was, while on leave last year, directed to visit certain forest offices in those countries, and I now proceed to lay before you, as shortly as possible, the results of the experience I gained there.

FRANCE.

On the 24th September, 1874, I went, in company with Colonel Pearson, to the office of the Director-General of Forests. He was absent from Paris, but M. Forstall, who was acting for him, took us over the portion of the office which is assigned to surveys and maps, and he also presented me with a book of instructions for the execution of forest surveys.

We subsequently visited the forest school at Nancy, where we were received by M.M. Mathieu and Bagneris, and M. Bagneris accompanied us into the Forêt de Haye near Nancy, and to a forest near St. Dié, in the Vosges. M. Herpin, the "Inspecteur" in charge, also accompanied us to the latter forest.

2. From conversation with the above-named gentlemen, and from the book given to me by M. Forstall, I gathered the following information :—

3. *Sub-division.*—The sub-division of a high timber forest is arranged as follows: those portions which are distinguished by differences of aspect, soil, growth, &c., are separately demarcated, and are called "parcelles." No separate "parcelle" need be made of an area less than 5 hectares (12½ acres), and if any exceed 150 acres they should be sub-divided. The partition lines should be made as straight as possible, and advantage should be taken of natural features or roads to form their limits.

A forest of large extent is sub-divided into "séries," each of which is to be subjected to the same general treatment, and the "séries" are further sub-divided into "affectations" which are arranged with reference to the project for management or the working plan. Each "affectation" ordinarily comprises several "parcelles."

In the case of coppice it is usual to divide each "série" into a number of equal or nearly equal parts, making use of natural boundaries as far as possible.

The limits of the "séries," "affectations," and "parcelles" are permanent, but the "parcelles" are for purposes of working frequently further sub-divided into "coupes," which are not permanent, and the limits of which are drawn on the map in pencil.

4. *Demarcation.*—The exterior boundaries of the forest are usually marked by a ditch with stones at the corners, but sometimes by stones only. The latter are usually 40″ × 10″ × 8″ and are buried to a depth of 2′. They are numbered consecutively, and bear on their tops engraved lines indicating the direction in which the boundary on either side runs. Sometimes the ditches are not continuous, but short lengths are made at the angles and at intervals along the straight lines.

The interior boundaries are not always marked by stones, and such of the partition lines as are not required for roads, are cleared of stumps to a width of about a yard, and are afterwards kept clear by the "Garde Forestier."

5. *Forest survey conducted by forest officers.*—The officers of the Forest Department execute special surveys of the forests. These are now all completed, and the maps are plotted on a large scale, but some of the reduced maps still remain to be drawn.

6. *Descriptions of maps.*—The maps are generally of two kinds, "plans d'assemblage," and "plans parciels;" but a third, showing each "parcelle" separately, is sometimes constructed.

7. "*Plans parciels.*"—The "plans parciels" are drawn on a single sheet of drawing paper, and contain one or more complete "séries." When the required area can be got into one sheet on the scale of $\frac{1}{2500}$ (25·34″ = 1 mile), this scale is adopted; and when this is not possible $\frac{1}{5,000}$ (12·67″ = 1 mile) should be adopted, but $\frac{1}{10,000}$ (6·33″ = 1 mile) is sometimes employed.

When a "série" consists of a number of detached portions which cannot be shown in their proper positions on one sheet of paper, they may be drawn independently on the sheet, each surrounded by a border, and a small scale plan of reference should be added in one corner.

The "partiel" maps contain all boundary marks, all traverse lines with their lengths and inclinations, and the area of each sub-division is written within it. All the details which have been surveyed are also shown, except the hills, which are not required on this map. The "plans parciels" are required on the large scale above indicated, to give a clear plot of the boundary, to leave room for the record of forest operations, and for computing the areas of fellings, thinnings, &c.

8. "*Plans d'assemblage.*"—The "plans d'assemblage" should represent the whole of one forest on one sheet of paper, and the largest possible of the following scales should be used, $\frac{1}{5,000}$ (12·67″ = 1 mile), $\frac{1}{10,000}$ (6·33″ = 1 mile), $\frac{1}{20,000}$ (3·16″ = 1 mile) or $\frac{1}{50,000}$ (1·26″ = 1 mile). It will contain the whole of the details shown in the "plans parciels," of which it is an exact copy on a reduced scale, the reduction being usually effected by proportional triangles. It will however contain no lines or figures of construction, and the hills will be shown.

9. *Colouring of the maps.*—The different classes of forest, as State, communal, or private, are distinguished by borders of different colours; the "séries" are also distinguished by borders, and the "affectations" by flat tints of colour; but the colours may be also used for showing the different species of trees, as resinous, deciduous, &c.; or for the different classes of crops, as "high forest," "coppice under high forest," "conversion of coppice into high forest," or "coppice."

10. *Marginal table.*—In the margin of each map should be added a table showing the names of the cantons, the names and numbers of the "séries," "affectations," and "parcelles" with their areas, and the mean age of the trees in each homogeneous "parcelle."

11. *Work in the field, triangulation and traversing.*—The code contains detailed instructions for the conduct of work in the field, and provides for the basing of the survey of all considerable areas on the data furnished by the Ordnance Survey. If sufficient triangulation does not exist, it must be supplemented by additional triangles, or main points must be fixed by the system of lieux geométriques, or by that of polygons.

Great accuracy is enjoined in this primary operation. The boundaries, exterior and interior, are to be traversed; but no instrument of greater accuracy than the prismatic compass is recommended for this purpose. The traverses are to be connected with the trigonometrical stations and computed and corrected by them. The amount of correction allowed is 1 to 0·2 per cent. for lines from 100 to 500 yards long, and 2 per thousand for longer lines. All details within 100 yards of the boundary should be surveyed, and the position of important objects within 500 yards should be fixed.

12. *Topographical details.*—The code contains minute instructions for the survey of topographical details, and states that the following should be shown on the maps, *viz.*: towns, villages, hamlets, farms, houses, clock towers, rivers, streams, ponds, pools, springs, fountains, swamps, floating places, railways, roads, paths, partition roads and rides or ditches, with boundary stones, embankments or cuttings, enclosures, hedges, walls, bridges, crosses, posts, rocks, mines, quarries, sandpits, marked trees, peaks, important ravines and ridges, and generally all features of the ground.

The altitudes of a certain number of points must be determined either trigonometrically or by levelling. The configuration of the ground is to be expressed by horizontal or vertical shading, or by contours. The latter should be at 35′ intervals when the scale is $\frac{1}{10,000}$ (6·33″ = 1 mile), and at half that distance when the scale is doubled. They may also be put in less accurately by levelling two or three contours, and filling in the remainder by eye from these.

13. I learnt, however, that in practice much attention is not paid to the accurate delineation of topographical features. Such of these as do not form boundaries are not surveyed, and such indications of them as are found on the maps are either enlarged by pentagraph from the ordnance map on the scale of $\frac{1}{80,000}$ (0·8″ = 1 mile), or are put in by guess-work; the latter being the usual plan.

The objects aimed at in the construction of the maps are, 1*st*, to obtain correctly the areas of the various sub-divisions of the forest; and 2*ndly*, to show their aspect. Washes of colour to indicate the general direction of the main slopes are considered quite sufficient for the latter purpose.

M. Bagneris said that the forest officers do not require accuracy in the representation of topographical details, and that it would be a waste of time and money to attempt it. He considered that generally the principal water-courses should be measured, and that such of the intervening ridges as do not form lines of sub-division should be put in by eye-sketch. During my visit to the Forêt de Haye I had the map in my hand, and I saw for myself that there was no attempt at accuracy in the representation of the hills, which had been enlarged by pentagraph from the ordnance map. This forest is on a plateau with slopes, some of them rather steep, running down to the Moselle and the Meurthe, and occasionally 400 to 700 feet in height.

I also had the map of the forest in the Vosges with me when I visited it, and I here observed a more marked inattention to topographical details. This forest is on a hill, and comprises differences of altitudes amounting to about 1,500 feet. The roads were put in by eye-sketch, and many large ravines were entirely omitted.

14. The forest maps are never printed, all the required copies being hand-drawn.

When the map of a forest consists of several sheets, these are bound together in an atlas, which contains in addition to the maps, a register of trigonometrical operations, plot of triangulation, table of areas, and table of fellings.

15. I have obtained the following French maps:—

1. "Plan d'assemblage" of the Forêt de Haye; scale 3·16″ = 1 mile.
2. "Plan partiel" of do; scale 12·67″ = 1 mile.
3. Plan of "parcelles" of do; scale 12·67″ = 1 mile.
4. Map of the Forêt Domaniale de Labourse; scale 12·67″ = 1 mile.
5. Map of the Forêt Domaniale de St. Dié, série la côte Saint Martin; scale 12·67″ = 1 mile.
6. Carte de France, showing the Forêt de Haye; scale 0·8″ = 1 mile.
7. Carte de France, showing the forests around St. Dié; scale 0·8″ = 1 mile.

SAXONY.

I received a letter of introduction to Herrn Oberforstratte Judeich, the Principal of the forest school at Tharandt, near Dresden, and on my arrival at Tharandt, I was met by Herrn Judeich with Professors Nobbe and Kuntze, from a discussion with whom I gathered that the following is the system of forest mapping pursued in Saxony.

2. *Sub-division and demarcation.*—The ground is carefully examined, and the areas stocked with trees of the same prevailing species and age are demarcated. The limits of these are dependent entirely on natural causes and previous treatment, and thus these sub-divisions (Parzellen) may be of any size; but differences of age or species covering less than 1-10th of an acre would not be noticed. Sufficient lines are cleared round these sub-divisions to enable them to be surveyed, and their boundaries are marked at intervals by zinc plates on trees bearing the number of the "Parzelle" in which they stand. When a forest is in good working order, the limits of these sub-divisions are readily distinguishable by the appearance of the trees.

The ground is further cut up into compartments of from 45 to 100 acres by cleared lines called "Schneissen." These are, unless they be also roads, not more than one yard wide; but the roots which occur on them are dug up, and the lines are regularly cleared every 5 years. It is not at all necessary for the "Schneissen" to coincide with the boundaries of the "Parzelle." The former are nearly always cut straight, while the latter will of course very seldom be so. The compartments formed by the "Schneissen" should be of nearly equal area in the same forest.

To divide a hill forest in this manner a line would probably be cut as straight as possible along the ridge; and transverse lines would be cut from this, in a direction approximately perpendicular to the lines of contour. If the opposite sides of the blocks can be parallel, or nearly so, they will be more convenient for subsequent forest operations.

The group of compartments which forms a separate protective charge is called a "section," and this is distinguished by a number. The compartments or spaces enclosed by the "Schneissen" are known by letters, and the "Parzellen" within them by numbers, as for example "A1, A2, A3, B1, B2, B3, Section II, Tharandter Revier:" where parcels 1, 2, 3, of compartment A, and 1, 2, 3, of compartment B, of the second Section of the Tharandt district are indicated. Stone pillars are used for the demarcation, both of the exterior boundaries and of the compartments.

3. *Forest Survey conducted by Forest Officers.*—Special surveys and maps of all the forests are made by the officers of the Forest Department. There is one superior officer at the head of the survey and working-plan branch; and the young officers on first joining the department from the forest school are attached to him for the purpose of executing any surveys that may be required, and for carrying out the periodical revisions. The forests have, however, all been surveyed and mapped long ago, and there is little surveying but that connected with the revisions. These relate chiefly to the records of age and species of the trees, since changes in the boundaries, roads, &c., are now seldom made.

4. *Descriptions of maps. The "Specialkarte."*—The same classes of maps are made for all forests, and they are as follows:—The "specialkarte" on the scale of $\frac{1}{7.200}$ (12·67″ = 1 mile), which shows all the exterior boundaries as well as those of the compartments and "Parzellen" with their names or numbers; all the topographical details which have been surveyed, all the boundary pillars with their numbers, also the names of the adjoining properties; but no hills are shown.

This map is kept in manuscript only. Two copies are made, one of which remains with the local forest officer, and the other is sent to the central office at Dresden. Each officer has the map of his own section only, and no combined map of the various sections composing each district is made on this scale.

When any felling or clearing operations are carried on, the area so treated is carefully measured and marked off on this map, and from it are calculated geometrically any areas which it may be necessary to ascertain or to lay down, any changes of boundary which may occur are also noted on it. The scale adopted is found a convenient one for these purposes.

5. *The "Bestandeskarte."*—The "Bestandeskarte" on a scale of $\frac{1}{36.000}$ (3·16″ = 1 mile) gives everything that is shown on the "Specialkarte;" but the parcels are coloured to show the difference in species and age of trees. The former are distinguished by differences of colour, and the latter by differences of shade. Each parcel bears the colour assigned to the prevailing tree within it, and slight admixtures of other kinds are not noticed; but when the latter occur in considerable numbers, their presence is indicated by spots of their colour. No hills are shown in this map.

The "Bestandeskarte" should contain, if possible, the whole of one "Revier" or district on a single sheet, and may thus comprise several sheets of the "Specialkarte" from which it is reduced.

Everything but the colour is lithographed in the Ordnance Survey office, and the following copies only are at first coloured, *viz.*, one for each officer in charge of a section, one for the officer in charge of the district, and one for the central office. The maps are coloured by hand, and when this has once been done the revision becomes an easy matter, as all fellings, &c., are recorded in the "Specialkarte," and the parcels which have not been touched between two periods of revision are merely advanced a grade in age, *i. e.*, they are coloured darker.

6. *The "Geognostische Terrainkarte."*—The "Geognostische Terrainkarte" is on the same scale as the "Bestandeskarte," *viz.* 3·16″ = 1 mile. This map is constructed for the purpose of showing the hills and geological formations, which are delineated on copies of the same lithograph as is used for the "Bestandeskarte."

7. *Work in the field.*—The survey of each forest is a separate and independent work, not based on the Ordnance Survey, which did not exist at the time the forests were surveyed. No triangulation was attempted. The boundaries, exterior and interior, and the roads, streams, houses, ponds, &c., were all surveyed by traversing with the plane-table and chain, no other instruments having been employed. The hills were not surveyed by the forest officers; those which appear on the "Terrainkarte" are copied by hand, in the Ordnance Survey office, from the original ordnance map on the scale of $\frac{1}{12.500}$ (5·28″ = 1 mile), which is published on the scale of $\frac{1}{25.000}$ (1·13″ = 1 mile). The geological formations are drawn by the forest officers.

8. *Revision of the maps.*—A careful revision of all the maps is made every 10 years, and if necessary a new "Specialkarte" is drawn, showing the latest additions and corrections, and a new lithograph is made. But unless ground has been bought and sold, or unless the forest has been so "converted" as to render a change in the limits of the "Parzellen" necessary, it is probable that the revision will consist entirely in re-colouring the "Bestandeskarte."

9. I have obtained the following maps from Tharandt:—

1. The Specialkarte of Section II Tharandter Revier.
2. The Bestanderkarte of the Tharandter Revier, with Section II coloured.
3. The Terrainkarte of do., with Section II coloured.

I visited this forest in company with the officers mentioned in my first paragraph, and studied the maps on the ground. The height of the hill tops above the valley is about 400 feet.

BAVARIA.

1. On arrival at Munich I obtained an interview with Herr Oberforstrath Baldinger, to whom I am indebted for the following information.

2. *Sub-division.*—The Reviere in Bavaria is broken up into "distrikte" each separately detached forest within it, even the smallest being so designated. Large extents of forest should be broken up into "distrikte" not exceeding about 750 acres in area, by separating those portions whose situation or circumstances render necessary a mode of treatment different from that of their surroundings; such, for example, as highlands, lowlands, or lands held under different tenures.

The "distrikte" thus formed are divided into compartments (abtheilungen) of from 50 to 150 acres by straight lines called "schneissen," which should be cut as much as possible at right angles to the prevailing winds, and which should, as far as possible, enclose portions of forest of similar age, species, and condition, and having the same soil and situation, the ultimate object being to bring each "abtheilung" into homogeneous forest.

Differences of age, species, or condition, which may be found within each "abtheilung" are then demarcated, these are called "unterabtheilungen," and they are subjected to such treatment as will tend to their subsequent assimilation. When this result has been obtained the limits of the "unterabtheilungen" are no longer preserved.

The sub-division of the forests is in the hands of a Royal Commission, which is also charged with the drawing up of the working plan; and which consists of a superior officer from the central office at Munich, with the provincial and local administrative and executive officers, each for his own province, circle or division. The Commission proceeds to the forest under consideration, and having there framed its proposals, submits them through the local Government to that of the Kingdom of Bavaria. When sanction has been accorded to their scheme, the lines of demarcation are laid down and cut by the local officers, and they are then surveyed and mapped.

If maps did not already exist, it would be necessary to survey and plot the outer bounds, rivers, roads, &c., before the Commission could enter on its work.

3. *Original Surveys not made by the Forest Department.*—Original surveys have not been made by the Forest Department, as the whole kingdom has been surveyed and mapped by other departments, and ample materials exist for the construction of forest maps. There is, however, a special branch of the ministerial Forest Bureau at Munich devoted to the preparation of the maps, which are all lithographed.

4. *Description of Maps.*—The same classes of maps are made for all forests, and they are as follows:—

"*Forsthauptkarte.*"—The "Forsthauptkarte" consists simply of the sheets of the revenue survey map (the "Steuerkarte") on the scale of $\frac{1}{5000}$ (12·67″ = 1 mile) which are adapted to the requirements of the department, and are sometimes reduced to half scale.

The "Steuerkarte," as prepared by the Revenue Survey Department, shows all the roads, rivers, streams, towns, villages, farms, &c., and the outer boundaries of the forests, both State, communal, and private, as well as those which are the property of charitable institutions; but it shows no hills, neither does the forest map which is made from it. The State forests are distinguished on the latter by a red border.

In all cases where the sub-division of the forests had been effected before the revenue survey was made, the limits of the "Reviere," "Distrikte" and "Abtheilungen" were shown in the "Steuerkarte;" when this was not the case, these, with the boundary stones, were surveyed by the forest officers, and plotted by them on to the "Forsthauptkarte." The limits of the "Unterabtheilungen" are not printed on this map, but they are drawn in pencil.

The special object of this map is to show the intricacies of the boundary on a large scale, and thus to facilitate the purchase, sale, or exchange of land. All such transactions are recorded on the map from time to time as they occur, and the lithograph is thereby corrected at the periodical revisions.

In a few exceptional cases where the boundary is so intricate that the scale of $\frac{1}{5000}$ does not suffice to represent it clearly, the map has been drawn on double that scale.

5. *The "Forstwirthschaftskarte"*—The "Forstwirthschaftskarte," or working map, is reduced by pentagraph from the "Forsthauptkarte" to the scale of $\frac{1}{10,000}$ (6·33″ = 1 mile), $\frac{1}{20,000}$ (3·16″ = 1 mile), or $\frac{1}{25,000}$ (2·53″ = 1 mile); 3·16″ = 1 mile is the scale usually adopted, and the largest is only used in cases where the course of the boundary is such that it could not be shown clearly on a smaller scale. The working map shows all the State and communal forests and those which belong to charitable institutions, which are distinguished the one from the other by borders of different colours. It gives all the details which are found in the map on which it is reduced, with the exception of the boundary stones, which are not required on it. The names or numbers of the "Reviere," "Distrikte" and "Abtheilungen" are lithographed, different kinds of type being used to distinguish them. The "Unterabtheilungen," are then added by hand in pencil, and they are coloured in various ways to represent the species of tree which they contain; four shades of each colour being used to show differences of age from 1 to 120 years in four equal periods.

When the country is marked by comparatively small hills or undulations, no hill shading whatever is added; but for mountainous districts second copies of the map are prepared, similar in every respect to those above described, but with the addition of the representation of the principal hills. These are copied from the Military Topographical Atlas on the scale of

$\frac{1}{50,000}$ (1·26″ = 1 mile). Sheets are generally cut up and mounted on cloth so as to give each officer concerned a map of the portion of forest that is under his charge, and pocket copies are also usually made to be carried about in the forests; these contain tabulated extracts from the working plan, showing the treatment which the various plots are to receive.

6. *The "Situationskarte."*—The "Situationskarte" is constructed by simply colouring on the sheets of the Military Topographical Atlas the limits of the circles and "Reviere" of the State forests and the outer boundaries of the communal and private forests, &c. Nothing smaller than a "Revier" is shown.

The Military Atlas is on the scale of $\frac{1}{50,000}$ (1·27″ = 1 mile), and is somewhat similar to the English Ordnance Survey maps. It contains all the topographical detail which the scale admits of, and is made independently of the revenue survey.

7. *General Map of the Forests of the Kingdom of Bavaria.*—There is also a general map of all the forests of the kingdom of Bavaria on the scale of $\frac{1}{200,000}$ (0·316″ = 1 mile).

8. *Work in the field.*—For the survey of such sub-divisional lines as were not laid down at the time of the construction of the revenue map, of the limits of the "unterabtheilungen," and of the clearings or fellings which are from time to time carried out in the forests, the local officers use the plane table and chain only.

9. *Revision of the Maps.*—A revision of the maps takes place every 12 years, and if necessary the lithographic stones are corrected, and fresh copies of the maps are struck off. Herr Baldinger very kindly took me over the office in which this was being done. I also visited one of the State forests near Munich in company with one of the forest officers, who brought with him his pocket copy of the working map, which I examined on the spot.

I brought with me the following maps:—

1.	A Sheet of the "Steuerkarte," scale ...	12·67″ = 1 mile.
2.	A "Forsthauptkarte," scale	6·33″ = 1 mile.
3.	A working map without hills, scale ...	3·17″ = 1 mile.
4.	Ditto ditto, scale ...	2·53″ = 1 mile.
5.	Ditto with hills, scale ...	2·53″ = 1 mile.
6.	Ditto ditto, scale ...	6.33″ = 1 mile.
7.	A general map of the kingdom of Bavaria (now obsolete), scale	0·316″ = 1 mile.
8. 9.	Two Sheets of the Military Atlas used for the "Situationskarte."	

I am sorry that I was unable to get any of these maps coloured, though I was very anxious to do so. When coloured the working map presents much the same appearance as the Saxon "Specialkarte."

BADEN.

For the following account of the system of forest mapping pursued in Baden I am indebted to Herrn Oberforstrath Roth, in charge of the estates of the Prince of Fürstenberg at Donaueschingen.

2. *Sub-division.*—Before commencing to sub-divide a forest, it is necessary to settle where the roads can most conveniently be made, and when the plan of these is arranged, the partition may be commenced. The main roads and their branches must be laid out so as to give access to every part of the forest; and they, with the ridges and water-ways, will form the basis of the sub-division.

In Baden the principal streams or valleys have been used to divide the forests into "Distrikte," for the size of which no rules exist. They are the portions of forest enclosed between the principal topographical features, and if any of those thus formed appear to be too large, they may be sub-divided at pleasure.

In hilly country the configuration of the ground is the only consideration in their formation, and it is not at all necessary that they shall be of equal size. In flat country they, as well as the "Abtheilungen," should be made rectangular; and the lines should be cut so that the prevailing winds may not sweep down them. These lines form the export roads, and such as are not required for this purpose need not be more than 6 feet wide.

Although, as above stated, the valleys or water-courses have been adopted as the natural limits of "Distrikte," Herr Roth recommends that the ridges be used for this purpose; and it appears to me that this would be the more suitable arrangement in the forests with which I am best acquainted.

When the "Distrikte" have been laid out, they are sub-divided into "Abtheilungen" by again using ridges, valleys, and roads within them to demarcate those portions which have different aspect, soil, &c. In hilly country it is not at all necessary for these sub-divisions to be of equal size; they should be laid out with reference chiefly to the configuration of the ground, the lines separating them being kept as straight as possible. No "Abtheilung" need be made of less than 50 acres, and none should exceed 125 acres.

In high forests of large extent the number of sub-divisions thus formed will have no connection with the periods of felling; but in small forests, which have to be worked independently, it is better to have twice as many as there are periods of 20 years in the growth of the trees. Thus if the period of growth be 100 years, there should be 10 "Abtheilungen."

When these sub-divisions are laid out, the parcels showing differences of growth or species within them are demarcated; but these (the "Unterabtheilungen") are not intended to remain distinct from one another, as one of the objects of the treatment they are to receive

is to assimilate the crop in each "Abtheilung." On this account the latter should not be made too large, otherwise it would be more difficult to attain this end.

3. *Demarcation.*—The boundaries are marked by hewn stones, bearing consecutive numbers, which are shown in the map. They are generally one foot above the ground, and about ten by eight inches horizontal section, and on their heads lines are engraved indicating the direction in which the next stones are to be found.

4. *Special Surveys made by the Officers of the Forest Department.*—Special surveys of the forests are made by the officers of the Forest Department.

5. *Forest map and reduced copies.*—The only map which has been made is on the scale of $\frac{1}{2500}$ (15·8″=1 mile); but the original drawing only is on this scale, reduced copies being lithographed for distribution.

6. It is considered a great object to show one entire forest on a single sheet of paper, and provided that this can be accomplished without too great crowding of details, any scale may be adopted for the copies. They can, however, never be less than $\frac{1}{50,000}$ (1·26″=1 mile) on which the Military Topographical Atlas has already been made, and it is preferred, if possible, not to use a scale smaller than $\frac{1}{16,000}$ (3·95″=1 mile). This map shows the whole of the boundary lines, and the stones (with their numbers), as well as the topographical details which have been surveyed; and has also a table showing the area of each sub-division.

The copies must contain the whole of the detail which is shown on the original drawing. All the details are lithographed except the limits of the sub-divisions ("Unterabtheilungen"), which are added in pencil. Borders of colour are used to indicate the various species of trees, and their prevailing ages are entered in a pencil note.

7. *Military Atlas.*—The only other map which is used by the Forest Department is the Military Topographical Atlas on the scale of $\frac{1}{50,000}$ (1·26″=1 mile), on which the boundaries of the Reviere only are shown.

8. *Work in the field.*—An old map was used for the purpose of laying down the lines of sub-division; and when these were all marked on the ground and cut, the surveyors set to work. They did not lay down the lines.

All the forest surveys were based on the data of the Military Topographical Survey. Additional points were fixed by triangulation; the boundaries, exterior and interior, were traversed with the theodolite and measuring staves; and the traverses were all computed and corrected on trigonometrical points. The roads, paths, rivers, streams, ponds, springs, towns, villages, farms, houses and all topographical details of whatever kind found in the map were surveyed by theodolite traverse. The plane table was never used. Every line that was traversed was also levelled, and differences of level of 20 feet were marked. As the ground was then covered with a network of levelled lines, the surveyors were able, if the ground was not very much broken, to sketch in the intervening contours from point to point; but, if necessary, intermediate lines of levels were run to give greater accuracy:—

9. I obtained the following maps from Donaueschingen.

1. A map of the "Distrikt" Ochsenberg about 8″=1 mile.
2. Another forest map on the scale of $\frac{1}{10,000}$ (6·33″=1 mile).
3. A map of the Rippoldsau Forest on the scale of 7·92″=1 mile.
4. } Two military atlas sheets of the country around Donaueschingen.
5. }

10. I visited the first-mentioned of these forests in company with the officer in charge of it, and was extremely interested by what I saw there, especially by the great skill of the woodmen in felling the huge trees.

GENERAL REMARKS.

1. *Method of sub-dividing forests, and its bearing on the scale to be adopted.*—In the above description of the system of surveying and mapping pursued in the countries I visited, I have roughly sketched the different methods of sub-dividing the forests, because this subject is most intimately connected with the two former.

The scale to which the maps must be drawn, and the amount of topographical detail which they must contain, depend in a great measure on the extent to which the forests are to be sub-divided for purposes of management.

In France areas of less than 12 acres are not demarcated; but in Saxony the smallest sub-division may be $\frac{1}{10}$ of an acre. Such small plots as these of course necessitate a map on a large scale; and if their limits are dependent on the formation of the ground, and if these cannot be decided on without the aid of a previously constructed map, representation of much topographical detail becomes a necessity.

On account of the comparatively high rates of pay drawn by officers in India, it seems unlikely that their numbers can be increased so as to reduce their executive charges to anything approaching the small size of those existing in Europe. The forest could not bear the expense; and I therefore think that, at any rate for many years to come, the Indian forests cannot be worked in the same detailed manner as those of the Continent of Europe.

If this be the case, a much less minute system of sub-division will suffice, and the maps need not be on so large a scale.

2. *The principal considerations at present are the scale and the amount of topographical detail required.*—The principal considerations at present are—

1*st.*—The scale of the maps which will generally be required.

2*nd.*—The amount of topographical detail which must be shown in them.

3. *Two classes of maps, "working" and "general."*—In the countries I visited there were generally two classes of maps; one on a large scale to record the details of the boundary, to assist in computing areas, and for other purposes; the other of a convenient and portable size for ordinary use. I think there is no doubt that we shall also require large scale and small scale maps; and it will be convenient to call the former "working," and the latter "general," maps. The latter can always be contracted from the former, and therefore the scale of the working map is the main consideration.

4. *Scales of the Continental maps—Large scale maps without hills.*—I will briefly summarise what I have before said regarding the scales of the forest maps in France, Saxony, Bavaria, and Baden.

In *France* the working map varies from 25″ to 6″ to a mile, a common scale being 12″, and it is without hills. The general map varies from 12″ to 1¼″ to a mile and shows the hills; but on whatever scale it may be, these are not regularly surveyed, but are put in either roughly by guess-work, or are enlarged from the published sheets of the military atlas on the scale of ·8″ to a mile; and this notwithstanding that the original atlas sheets are on the scale of about 5″ to a mile, and that the hills could of course be put in much more accurately from them.

In *Saxony* the working map is on the scale of 12″ to a mile, and is without hills; the general map is on the scale of 3″ to a mile, the hills on it being copied from the original sheets of the military atlas on the scale of about 5″ to a mile, which is fortunately at hand for the purpose.

In *Bavaria* the working and general maps are on the same scale as those of Saxony; but the general map is sometimes on the scale of 2·5″ to a mile. The working map is without hills, and the general map shows them in mountainous districts only. When they are required they are copied from the Revenue Survey maps on the scale of 12″ to a mile.

In *Baden* one map only is in possession of the executive forest officer. The results of the survey are originally plotted on the scale of 16″ to a mile and without hills; but reduced copies only are issued on scales varying from this to that of the military atlas (1¼″ = 1 mile). On the reduced maps the hills are shown by a moderately accurate system of contours, and it is preferred that the scale be not less than about 4″ to a mile.

It will thus be seen that the prevailing scale for working maps without hills is 12″ to a mile, and for general maps 3″ or 4″ to a mile, but the latter may be anything down to 1¼″ to a mile.

5. *Topography in small-scale Continental maps.*—The smaller scale, or, as I have called them, the general maps, always contain hills. In France but little attention is paid to their representation, and the most accurate method is to enlarge them from a map on 1¼″ to a mile; in Saxony and Bavaria large scale topographical maps happen to exist, from which they can be copied; and in Baden only are they specially surveyed for the forest maps.

6. *Extract from Mr. Brandis' report on the operations of the Forest Survey.*—I will here invite attention to paragraphs 5 to 8 of Mr. Brandis' memorandum of 6th January 1875, on the operations of the Forest Survey. He treats of the object of the making of forest maps, of their scale, and the amount of detail which they should show.

"5. Speaking broadly, the use and object of forest maps may be said to be three-fold *first*, to represent the situation, and, as far as may be practicable, the topography of the forests; *second*, to fix the limits of the forests, and to facilitate the settlement of questions of encroachment and boundary disputes; *third*, to ensure the systematic working of the forests, by the representation on the maps of internal division lines and the determination of the area of compartments. The main point to be kept in view must be to attain these objects with the least possible expenditure of time and money; therefore no more topographical detail should be attempted than is necessary, the smallest scale which will answer the purpose should be selected, and lastly, all existing work should be utilised as much as possible. In the printed maps no detail should as a rule be shown which is not of a more or less permanent nature. The character and age of the forest in the different compartments will from time to time be entered by hand, but there are certain lines, such as that which separates sál from khair and sissu forest, which depend upon the configuration of the ground, and are therefore permanent. Such lines should be entered in the printed maps.

"6. It is evident that the most detailed and accurate maps will be required in demarcated forests which are worked to their full extent, so as to utilise the entire annual production in the shape of stem-top and branch-wood and other forest produce. In such cases it is essential to know the area of each compartment, and to be able readily to ascertain the area of any portions of compartments which for convenience of working it may be desirable to separate from the rest. To this class belong, among others, the Deoban forests, which furnish fuel to the station of Chakráta, and the plantations in the plains of the Punjab. The working maps of such forests must be on a large scale, and must contain as much topographical detail as possible.

"On the other hand, much less detailed maps will be required for reserves which, though demarcated, are not at present fully worked, but in which the main work will be protection and the keeping out of fires. Again, if forests of this description are burdened with forest rights or privileges which it may be possible hereafter to commute by the abandonment of part of the area, more detailed maps will be required at the present time than in tracts which are at the complete disposal of the State.

"Lastly, for forests the boundaries of which have not yet been demarcated, and in many other cases, sketch maps will generally be sufficient for the present.

"7. The following sketch of the work to be done by the Forest Survey Department is not intended to exhaust the subject. Other wants will become known long before the work here indicated is completed, nor must it be imagined that on the completion of any particular survey the work of the department will cease in that forest. The survey of the Dun forests, for instance, has laid down the present Government forest boundaries; the greater part of these forests, however, is so burdened with grazing privileges that protection from fire is impossible, and this can only be altered by abandoning to the privilege-holders part of the forest area. Again, it has, we understand, been decided to give up for cultivation part of the forests in the Eastern Dún, so that it may be considered as certain that before long great alterations will take place in the boundaries now laid down on the maps.

"8. Nor will it be possible in all cases beforehand to mark off on the ground the sub-division lines between blocks and compartments. The formation of these sub-divisions for the purpose of organizing the systematic working of any forest is a most important operation which requires long previous study of the forest, a knowledge of the demand for its produce in different directions, of the sources of labour, and of the treatment to which the different parts of the forest must be subjected. This operation will be of a more simple character on level or gently and uniformly sloping ground where the division lines may be straight, than in a hilly country, but it cannot as a rule be completed before the topographical survey of a forest is commenced. In many instances the topographical survey must serve to facilitate

this operation by laying down on the map the position of permanent points or lines likely to be useful in sub dividing the forest. Some of these will be artificial such as boundary marks, walls, bridges, roads and paths; others—and these will often be the more valuable of the two classes—are natural land marks such as ridges rocks high banks, jheels streams, their junction and the like. The selection of the topographical features to be entered on the map which this will involve, renders it desirable that the topographical forest survey should be conducted by an establishment trained for this special work

In some cases the demarcation of the forest may not be completed at the time the survey is made, and thus there will be constant calls for the additional survey of boundary and subdivision lines, after the survey of any forest district has for the time being been completed

"With the view to the entering afterwards of additional detail on the maps, it is essential that those points and lines which are surveyed should be laid down with as much accuracy as possible, and that a complete record should be kept of the procedure The first survey of a forest will often lay down the position of a few points and lines only, but whatever work is done must be done accurately, so that it need not be done over again by others, and may furnish safe starting points for the survey of additional detail at a future time"

7. *Considerations which must govern the scale of the working maps* —It is essential that the scale shall be sufficiently large to shew the boundaries distinctly, and the topography in their neighbourhood should be shewn with great accuracy, so that the map may form a reference in case of disputes

If in the interior of the forests, it will suffice to shew only the roads and lines of subdivision, if, in fact, the map be a mere skeleton, the amount of labour to be expended in the field will be the same on whatever scale the map be plotted, and it is therefore but little more expensive to produce a map of this kind on a large than on a small scale. But it must be remembered that if the scale be very large, the map becomes very unwieldy, as it will consist of a large number of separate sheets, and in the European countries, of the forest maps of which this memorandum treats, the size of the scale is often sacrificed to the great convenience of having the map of each forest on one sheet of paper.

The very large size of the generality of our Indian forests thus becomes one reason for making the scale as small as possible

If again, whatever scale may be adopted, the whole of the details which it can shew must be surveyed it becomes of the utmost importance to reduce the scale, for the cost of the work increases enormously with increase of scale—and in some cases is said to vary in proportion to the square of the latter,—the cost of the 2″ and 4″-scale being as 4 to 16.

I do not consider that it will generally be necessary to survey everything, the representation of which the scale admits, it is quite possible, however, that a moderately large scale may be needed for reasons other than the representation of minute features of the ground—(*e. g*, intricate boundaries or unusually small subdivisions), but whenever the whole of the details which it may be possible to shew are not put in, a difficulty arises as to the selection of those which are to be surveyed, and an increased amount of intelligence in the surveyors, as well as an increased amount of professional supervision, is required. On this account the scale should be kept as small as possible

In considering the scale which will generally suffice for the distinct representation of the forest boundaries, I would observe that the Bengal Revenue Survey Department survey the village boundaries on the scale of 4 inches to a mile and print the maps on a quarter of that scale only What is sufficient for the record of village boundaries ought generally to suffice for those of the Government forests, I see no reason for increasing the scale beyond 4 inches to a mile on account of the boundaries, and I think it very probable that the scale of 2 inches to a mile may often suffice for their representation.

It is difficult to say what the size of the smallest subdivisions may be, but, as on the 4-inch scale an area of 40 acres is represented by one square inch, and one acre can be readily and distinctly shewn, I do not think that this consideration is likely to require a larger scale, but I think that on the 2-inch scale the smallest subdivision will in many cases appear large enough for all practical purposes

As to the capacity of shewing topographical features which the 4-inch scale possesses, I think if I mention that on this scale any feature of one chain in length can readily be shewn, it will be thought quite sufficiently large

8 *Amount of Topographical detail required in the working map* —Next as to the amount of topographical detail which it is necessary to shew in the maps

I do not myself believe that minute topographical details are required. If it were possible to complete the subdivision before the survey, I think that it would suffice to survey only the outer boundaries and lines of subdivision, together with the roads, buildings, bridges and such similar details which any map must as a matter of course contain

Whenever it may be possible to effect the subdivision in advance of the survey, this should be done. It is, however, exceedingly unlikely that the generality of our forests, many of which are imperfectly known, can be subdivided until some kind of topographical map is made.

Note—Vide pages 62 63 of the report of the proceedings of the forest conference, 1873 74

Preliminary Topographical Survey —It will at least be necessary to make a preliminary topographical survey, confining our attention to the outer boundaries, the roads and such features of the ground as will probably be used in the partition, leaving as many marks as possible by which the survey may be continued at any future time This preliminary work should be executed with all the accuracy of a scientific survey, as it has then never to be re-done, its extension is an easy matter, and it admits of ready incorporation with other similar surveys The skeleton map thus constructed may be rendered more intelligible by the addition of a rough and lightly-drawn indication of the general lie of the ground, not in itself pretending to accuracy, but serving to connect the features which have been surveyed, and to make the map more readable The map should be so drawn that all details which are

accurately surveyed may be readily distinguishable from the rough indications of the lie of the ground which I have above suggested.

As the partition of the forest proceeds, it should, if the surveyed features have been judiciously selected, generally be possible to enter the boundaries of the subdivisions without further survey; when it is not so, they must be surveyed, and, as soon as all the permanent lines of subdivision are laid down on the map, a new edition of it may, if necessary, be issued.

Changes of the outer boundary must be similarly surveyed and added to the map. Without some kind of topographical map, I think it would, in most cases, be exceedingly difficult, if not quite impossible, to carry out the subdivision of a forest, to mark off grazing ground, to give up land for cultivation or to carry out any such operations; and if we can stop anywhere short of a complete topographical survey, we ought to do so; we cannot afford to do a stroke of work which is not necessary for the special purpose for which we are working.

If the system above suggested can be carried out, it will no doubt prove cheaper than a complete survey such as I am now making in Dehra Dún. I am about to attempt it in Jaunsár (North-Western Provinces) and am hopeful of success.

9. *General maps.*—On whatever scale the working maps may be, the general maps can be reduced from them to any convenient scale. Where the topographical survey maps on the scale of 1 inch equal to 1 mile are available, it will generally be sufficient to transfer the outer forest boundaries and main subdivision lines to them; and in some cases this may be sufficient without the construction of the large-scale working map.

10. *Records of forest growth, &c., to be made on the maps.*—It will be seen from the specimen maps which I have brought, that different colours and different shades of the same colour are employed to indicate either different classes of forest, or different species of trees, with their ages.

This system is carried out very elaborately in Saxony and Bavaria, but less so in France and Baden, where the written description is more depended on. Information regarding area, class of forest, species, quality or age of the crop, as well as records of felling, thinning, &c., may be made in two ways, *viz.*, either on the map or in the descriptive account which should be kept for each compartment. The amount of such information which it may be possible to record on the face of the maps will depend on many variable circumstances, such as the size of the subdivisions when plotted, and the uniformity or otherwise of the crop.

The subdivisions should always be large enough on the map to admit of the insertion of a distinguishing letter or number being written within them; but the areas may be conveniently given in a marginal table. Coloured border washes or ruled lines may be employed to distinguish the various classes of forests or to bring into prominence the limits of the permanent subdivisions; while flat tints of colour may be used to distinguish the prevailing species of trees, with letters to indicate the presence of other species, and numbers to shew the quality or age of the prevailing crop as may be desired.

Specimens of these methods may be seen in the Deoban sketch map and in the new Dehra Dún map. The symbols to be employed will vary as circumstances may demand; but, whatever they may be, it is essential that a table of references be added on each sheet of the map. It is very undesirable to crowd the map up with numerous details, and, rather than do this, I would trust to the written description; but the comparatively small cost of multiplying copies of maps by photozincography enables us to use separate copies for the record of different kinds of information, and this is a very great convenience.

11. *Revision of the maps.*—When once a map with all the lines of permanent subdivision has been made, any corrections or alterations which may from time to time be required can be readily executed by the local officers; but, in case of the changes being so numerous as to necessitate a new edition of the map, this should be prepared by the special department.

12. *Boundary stones and marks.*—The system of numbering and marking the boundary stones described in my notes on the maps of France and Baden may be found useful.

13. *Special department for forest maps.*—I may here remark that in all the countries I visited except Bavaria a special department for forest surveys and maps exists. In Bavaria it happened that a very complete survey existed before the forest maps were required, but these are now constructed by a special department.

A few remarks were made by *Dr. Schlich* as to the utility of making sketch maps beforehand, and after *Captain Bailey* had replied, *Mr. Shuttleworth* communicated the following notes on the survey in the Bombay Presidency:—

The Bombay Presidency has been surveyed over by the Local Revenue Survey Department who have prepared maps of each village on a scale of 10 chains to the inch, *i. e.*, 8 inches to the mile, and taluka maps on a scale of 2 miles to the inch. The Great Trigonometrical Survey of India has also worked over the greater part of the presidency, and the Topographical Survey Department is now working in Guzerat, Khandeish and Kattiawar. These surveys will, it is presumed, supply all the wants of the Forest Department in maps, and therefore it does not seem desirable to introduce a separate office of Forest Survey into Bombay.

When forests are demarcated in Bombay the course proposed in order to obtain maps of them is to join such village maps together, the forests of which form continuous tracts or blocks and then to lay down and fix the boundary line upon them. These village maps shew the topographical features of the country, the size and situation of every field in the village, the village site, in fact every description and sub-division of land in the village, every ravine, nullah, water-course, well and road. After the demarcation has been sanctioned, it is proposed

to reduce the map of the forest block only, in the Conservator's office, to a scale of 4 miles to the inch, and then to strike off in the photozincographical office as many copies as may be required for issue to the several district offices.

There are a few parts of certain districts which have not been surveyed by the Revenue Survey. For instance the waste country within the limits of the Satpura range. Such tracts are now being surveyed by the Trigonometrical and Topographical survey parties, who are producing 4-inch maps which shew every necessary topographical detail. In this way we have ready to our hand large-scale maps of all different kinds of jungle.

Forest officers in Bombay are required to acquire a knowledge of surveying, and they, with the assistance of native surveyors, will be able to enter with accuracy into the maps the different descriptions of forest trees and other details required to assist in the preparation of working plans.

Colonel Thuillier remarked that nothing could be better than the system inaugurated by Captain Bailey, and that his maps would be of the greatest possible advantage to the Forest Department. He also said that, where his own surveyors were at work, he would be most happy to lend every assistance to forest officers in mapping any particular portions that might be required, but it was most essential to have the boundaries settled and demarcated beforehand. He would also undertake to print off any number of copies of skeleton maps which were sent up to him.

Captain Campbell Walker, speaking for Colonel Hessey, who was specially deputed by the Madras Government to attend the conference, but who was prevented by illness from being present, said that he (Colonel Hessey) considered that in the Madras Presidency the mechanical part of the final demarcation, *i. e.*, the erection of the *permanent* boundary marks, would be best carried out by the trained demarcators of the revenue survey department, in conjunction with the local forest officers, all questions as to forest rights and privileges having been previously settled by the district civil and forest officers; hence in his opinion the services of a special forest survey branch were not required in Madras. Some further discussion ensued on the best kind of boundary marks to use, and as to whether the nature of the forest growth should be indicated in the maps, in which Colonel Thuillier, Captain Bailey, Messrs. Shuttleworth, Gibson and others joined; and then *Mr. Brandis* made some general remarks on the object and duties of the forest survey branch and thanked Colonel Thuillier for the interest manifested by him in the work of the forest survey, and for the excellent advice he had been good enough to give.

Lieutenant De Wolski, Royal Engineers, then read a paper on the "working of wire rope tramways," with special reference to an existing tramway at the Mayo salt mines in the Punjab. (*Note.* This paper will be published separately by the author.)

Mr. Brandis thanked Lieutenant De Wolski for his communication, which was most useful, as it gave forest officers present clear notions regarding the different kinds of wire tramways used. Excellent timber slides and shoots had been constructed in the Himalayan forests of the North-Western Provinces, under the direction of Mr. G. Greig, for the purpose of bringing down large quantities of railway sleepers for the construction of the new lines in Rajputana. Upwards of half a million of sleepers had been brought out from the Mundhole and Lamba Taj forests on the Tonse river, by means of skilfully devised systems of tramways and slides. There are, however, places in the Himalaya where slides and ordinary tramways cannot be built, and where wire rope tramways of the simplest construction, with fixed ropes, may be found the most economical mode of bringing timber or fuel down precipitous slopes or across impracticable ravines. Lieutenant De Wolski would, he felt assured, be glad to give advice and assistance to any forest officers who might wish to construct a wire rope tramway such as had been suggested, to facilitate the carriage of wood or timber, and he was authorized to state that Mr. Guilford Molesworth, who had listened to Lieutenant De Wolski's paper with great interest, would be happy to give any assistance in his power in this matter.

Reserves in the Maidan Taluks of Mysore.

Captain VanSomeren then read his paper on the above subject as follows:—

The Inspector-General of Forests having asked me to read a paper on the Forest Lands in the maidan or plain taluks of Mysore, I have put together a few notes, which I venture

to lay before you. To make them clearer some general remarks on the province will be necessary; but I will not tax your patience, I trust, too much, or for too long a time.

Mysore measures 27,000 square miles.

The structure of the country is entirely primitive. The great rock, which may be said to constitute the basis of the whole country, is a kind of sienite, composed for the most part of quartz, felspar, hornblende and mica, the felspar being the chief.

It is bounded towards the west by the Western Ghats of India and a part of Coorg; and farther east is a second series of rocky hills which runs somewhat parallel to the Ghats up as far as Madagiri in the north, and other minor ranges intersect the province. The term "plain taluks" is somewhat misleading, for Mysore is in many parts mountainous and *everywhere* undulating, and a marked feature of the country is the number of isolated rocky hills which, when fortified, as many are, are called Droogs.

During the first quarter of the year the winds are easterly; in April and May they are variable, blowing round from south-east to north-west. From June to the end of September, the prevailing winds are south-westerly. In October they again become variable, and work round to north-east and east.

Bangalore, the principal town in the country, lies at an elevation of 3,030 feet; the mean elevation of the country is, however, somewhat lower.

It has a population of 150,000, including a garrison of 2 European Regiments, 3 Batteries of Artillery, 2 Native Regiments, and is the head-quarters of the Sappers and Miners, and some Irregular Native Cavalry and Infantry. There is thus a great consumption of fuel.

Referring now to Mr. Brandis' rain map, the Western Ghats and the country adjoining and immediately to the east thereof lie within the moist zone. Further east, a narrow strip, spreading itself out at both its northern and southern extremities, is within the medium zone, while east of this lies the dry zone, where the rainfall is 30 inches and under. The town of Bangalore is in the dry zone, but the rainfall is higher than elsewhere in the neighbourhood. A statement issued in the administration report for 1871-72 gives the mean rainfall, calculated over a period of 30 years, as 35·26 inches.

From a forester's point of view, the province may best be divided into three belts, the respective limits of which can be very fairly defined, and coincide generally with the rain zones. A glance at the rough map now before you will shew more clearly than many words what I mean. The darkly-shaded portion is the *evergreen belt* lying along the Western Ghats and varying in breadth from 6 to 12 or 14 miles; the lightly-shaded portion represents the *mixed belt*, varying from 10 to 45 miles in width; and all the rest of the province is included in the *dry belt*. The most valuable timber trees occur in the mixed belt; while in the *dry belt* stunted teak is found interpersed with several trees of the mixed belt, but which are here of very depressed growth.

On the map I have set off by double lines most of the tracts of land in the dry belt which are of appreciable extent and either carry or can be made to carry low forest. There are altogether sixteen such tracts, of which eight belong to the Forest Department, and these are distinguished by the letters F. D. These eight tracts cover an area of about 78,720 acres, or 123 square miles. Measures are in progress for the transfer to the department, for general management, of an area lying between the Nundydroog and Devaroydroog forests of some 200 square miles; and in the Sira taluk of about 50 square miles; the prevailing tree on this latter tract is the Karachi, *Hardwickia binata*. These additions will provide the divisional forest officers with work sufficient to keep them very well employed for the next six years, when certain changes may occur in the Government of the province.

The most desolate and denuded portion of Mysore is the Chitaldroog district in the north. Here, as the map will shew, there is scarcely any wood, and the rainfall is very scanty. Towards the north is an old and utterly ruined forest of *Hardwickia*, which has for years been pollarded and lopped, till not a seedling is to be seen over hundreds of acres. The district suffered severely in the famine of 1866, when an old saying was revived that Chitaldroog produced nothing but "Kallu mathu kallaru," "stones and thieves." But the district is very thinly populated, and the endeavours to raise trees and vegetation are entirely at present in the hands of the district officers. In portions of the adjoining districts of Hassan and Kaddur, there is little forest land, but the people supply themselves with both fuel and wood for building from the date palm, *Phœnix sylvestris*, which grows here in great abundance. There are also under tanks, fine gardens of cocoanut and areca nut palms, with mango, tamarind, and other fruit trees interspersed, which yield a sufficient supply for local wants. In the adjoining portions of the Toomkoor district there is not much wood on the waste lands, the *Butea frondosa* being rather common but very small, and local wants are met from the supplies afforded by the gardens under tanks, and the trees grown in the hedges of these gardens. It is not until the Bangalore district itself is reached that the very urgent need of wood, not only for building purposes, but even for fuel, is felt. This need is now very pressing. The jungles for miles around Bangalore have all been swept away, and wood-fuel is now brought from distances of fifty miles and more. Those portions of Toomkoor which adjoin the north-west of the Bangalore district are not only denuded of all wood, but the very roots are being grubbed up. The nearer portions of the Kolar district on the east have also been cleared, and petitions regarding the high prices of wood-fuel and charcoal have been sent in to the Chief Commissioner by the townspeople. These petitions have been referred lately to the Conservator, with a request that the state of the firewood market, and the conditions of supply at the present time and for the past ten years, be inquired into, reported upon, and measures suggested for an improvement in the state of things.

In the south of the Bangalore District, and situated between the Cavery and the Arkavatti rivers, and the Arkavatti and the Madras boundary, and among rocky hills, is a tract of wooded land measuring by estimate some 35,000 acres, which is held by the department. It is, however, fully fifty miles away from Bangalore, and at present is practically inaccessible owing to the want of roads and the natural difficulties of the country. It will doubtless result that roads will be made out to this tract, which will then be worked systematically. It is not a regularly stocked forest; but consists of trees scattered, more or less plentifully, over hills intersected by ravines and gullies.

The Forest Department, in Mysore, levies no tax on firewood. The Revenue Department has for some years past levied a seigniorage of 6 annas per cart-load on all fuel felled in the Mirlwadi jungles, which are under its management. But this has had no appreciable effect in preventing the denudation of these tracts. The Deputy Commissioner of the district has just asked me whether I can open any of the tracts closed by the Forest Department, as the supply from Mirlwadi is running short and the price of fuel increasing. At present, wood-fuel in Bangalore costs about 13 annas 4 pies per Bengal maund, if bought by the cart-load. In Simla I am told that charcoal sells at 12 annas per Bengal maund. The urgent need of forest operations and forest conservancy is, I think, fully established.

The supply is now drawn from the lands of inamdars, who sell their wood, and from any Government waste which will yield any fuel at all. It would be simply useless, as well as a difficult matter, to levy a seigniorage on such wood. Matters have gone too far.

I have already indicated the localities which have as yet been taken up by the forest officers with the view of reproducing forest on land which once was wooded, and which can be again clothed with trees. Premising that there is a family likeness between all these tracts, inasmuch as they all lie among rocky hills with great masses of stone cast about them in wild confusion, I will describe our work and its results in one forest, situated from Bangalore about fifty miles by road and seven miles from Toomkoor. This is known as the Devaroydroog forest of the Toomkoor District. It lies in a basin enclosed by six large and several smaller hills. The large hills may be roughly grouped into two semicircles, placed at a little distance from each other and connected by the smaller hills. The Devaroydroog hill itself rises about 1,100 or 1,200 feet above the level of the surrounding country; the five others are from 500 to 900 feet above the same level. A road runs from Toomkoor town through this basin and leads up to the temple on the top of Devaroydroog. About the middle of the basin is a tank, up to which point the road is practicable for carts. Near this tank there were formerly two hamlets surrounded by dry cultivation, and some wet cultivation exists below the tank.

Conservation was first commenced here by General Dobbs, who was formerly the Superintendent (or, as it is now called, Commissioner) of the Division. This gentleman, who had built himself a house on the top of the hill (an example followed by one other man), conserved the jungle on and immediately around the large hill and along a portion of the road. During the hot weather the road was open, but closed during the rest of the year. This did not, however, prevent the removal of fuel by head-loads, the trade being almost entirely carried on by Lambarris, who lived in small hamlets close to the hills. The whole area was regularly grazed and burnt. In 1866 the capabilities of the land, and the necessity of commencing to provide in this locality for the future, attracted the attention of the forest officers. In January 1867 four guards were put on to protect certain portions, and when, in 1869, better forest rules were introduced, an area of eighteen* square miles within the basin was made over to the Forest Department by Captain Charles Pearse, the Deputy Commissioner of the District, who rendered the department invaluable aid. The staff of watchers was increased to six; all grazing and cutting of fuel or wood of any description was entirely stopped, and demarcation lines, 21 feet in width, were cleared all round the forest. The inhabitants of the two small hamlets were bought out for Rs. 600, and the whole forest placed under the charge of the forest officers without any reservation but one,—that is, that small wood, to a maximum quantity of five cart-loads, shall be given free annually for the use of the pilgrims who yearly resort to the temple at the Shivaratri feast. The maximum has not yet been taken in any one year.

Arrangements were soon made towards forming a plantation of *Jaman, Acacia speciosa* and *odoratissima, Terminalia, Neem, Casuarina,* and other second class timbers in the old cultivated land. Work was thus provided for many men who had hitherto lived by the sale of fuel.

It is not pretended that all this was done without any trouble, and some temporary inconvenience to the surrounding villages; but, owing to the explanations which were fully entered into with the people, and the cordial aid of the revenue officers, these radical but necessary measures were carried out thoroughly.†

† The cost was as follows:—

	Rs.
4 watchers for 2 years, at Rs. 6 each per mensem	576
6 watchers for 6 years, at Rs. 6 „ „ .	2,592
Compensation	600
TOTAL .	3,768

The results have been most satisfactory. Since 1866 the forest has escaped all fires, with the exception of a small patch of about half an acre. The grass was accidentally fired by some pilgrims, but fire was promptly extinguished. As a further precautionary measure, the repairs of that portion of the road which is within the forest are carried out by the department as the contractors for the District Funds Board.

* This is the area arrived at by a compass survey. But I think there must be some mistake, and that it is not more than sixteen. The Revenue Survey will shortly settle the point.

The growth of young trees from old roots, and of new seedlings, has been most marked. Blank spaces have been gradually filled up, and on the hill sides new soil is forming. The growth is chiefly kagli (*Acacia Catechu*), chiqare (*Acacia sp.*), small dindiga (*Conocarpus latifolia*) in parts, hoinge (*Pongamia glabra*), *Lagerstriemia parviflora*, huluve (a *Terminalia*), gern (*Semicarpus anacardium*), and in one portion *Acacia speciosa*, and elsewhere teak poles of small size have sprung up from old stools. Very little cutting of any kind has been allowed since 1869, the object being to get the soil covered with vegetable matter to renovate it. Bushes have been cleared away near the tank to admit of the new plantings, and small stunted trees have also been removed for the same reason. The sale of these teak poles of small size have yielded about Rs. 1,200 in all. During the past season thinnings were made over a small area as an experiment to see whether poles of *Conocarpus* and *Terminalia* would be strengthened thereby, but this has been stopped.

It is a difficult matter to state in figures the average height of such a forest, but I can safely say that many parts which, nine years ago, were almost bare of trees, are now covered with a growth of not less than 8 to 10 feet in height, and frequently very dense.

It is in contemplation to fell all the wood over an area of 25 to 30 acres next year, this area being so selected as to enable us to arrive at an average of what yield we may expect by enclosing land elsewhere, under similar conditions of climate, soil, and position.

North of the Devaroydroog forest, and connected with it by a broken chain of rocky hills, lies the Maddgiri forest, where we have been working on the same system for about four and a half years with encouraging results. Here, however, we are obliged to allow grazing and the collection of bushes for manure under certain restrictions.

Due east of Devaroydroog and about thirty miles off is the Nundydroog forest (of about seven square miles), now enclosed and protected for about four years. Here *Vatica lanceæfora* and *Rottlera tinctoria* are beginning to recover themselves among other trees; small bamboos are fairly abundant, and large quantities of seeds of various trees have been dibbled in on parts of the hill. The forest has, however, been twice burnt in parts. Between these two forests of Devaroydroog and Nundydroog lies that tract of land to which I have already referred as covering some 200 square miles, which it is proposed to re-afforest. The problem is a difficult one, as we must manage to so work as not to deprive the ryots of several villages of their just rights and privileges with regard to wood and grass.

Other measures in progress for the improvement of the country, by growing trees, are the formation of large plantations, mostly east of Bangalore, and with a very scanty rainfall. Here we grow our young trees in nurseries till they are from 2 to 2½ feet high, and then put them out in 3 feet cube pits. When it is remembered that circumstances are such that irrigation is impracticable, the true economy of our present system may be acknowledged in theory, *and what is more it is proved by practice.* After what Mr. Wallinger has told us of the good effects of broadcast sowing in Bombay, I shall certainly not omit in future to add this means to others already pursued by us in Mysore. I could not close this paper without referring to the vigorous and successful operations of the revenue officers in their avenue and village grove work. Such trees of course are raised neither for fuel nor timber, but for the general improvement and ornamentation of the country, and the convenience and ease of the people.

In conclusion, I would express a hope that what I have just had the honor of telling you regarding the denuded state of a great portion of the forest lands in the dry belt of Mysore, and the inconvenience, nay hardships, resulting therefrom to the people at large, may help to induce the revenue officer as well as the forest officer to expunge from his *Thesaurus of Words and Phrases* that mischief-working collocation of words, "this forest is practically inexhaustible."

Plantations and Firewood Reserves in the Madras Presidency.

This was succeeded by *Captain Campbell Walker's* paper on "the Plantations and Firewood Reserves in the Madras Presidency."

1. Plantations.

The plantations under the Imperial Forest Department in the Madras Presidency extend over an area of 7,000 acres in round numbers, of which 3,386 acres are classed as "timber," 2,323 "firewood," and the remainder as "mixed" and experimental plantations.

The great proportion of the timber plantations consists of teak, the magnificent plantations at Nilambúr alone having now a planted area of upwards of 3,000 acres.

The area under sandalwood, artificially reared, is still small, 158 acres, and other timber-planting operations are still in an experimental stage, though I must not forget to mention Mr. Yarde's successful plantation of Red Sanders (*Pterocarpus santalinus*) at Codur in the Cuddapah district, which although small (50 acres), has passed out of the experimental into the successful stage, and which it is proposed to extend.

The firewood plantations may be grouped under (1) plantations of *Acacia arabica, A. amara, Albizzia Lebbek, Inga dulcis*, &c., in the Cuddapah, Bellary, and Trichinopoly districts; (2) *Casuarina* plantations on the sandy seaboard and river banks in the districts of North and South Arcot, Cuddapah, and Trichinopoly.

The accounts of the extensive plantations (926 acres) of Australian trees, Eucalypti and Acacias, on the Nilgiri hills, having unfortunately been mixed up, it is impossible to divide

them according to their proper class of timber or firewood, and they are, therefore, included under mixed, but instructions have now been issued to ascertain the areas under which they may be respectively classed.

The experimental plantations, which are, as a rule, of small extent individually, cover 204 acres in the aggregate, and include all descriptions of trees whether grown for timber or firewood. These experiments have not been without value, though doubtless they have often been undertaken with too little previous consideration, and conducted with little professional knowledge and want of sufficient supervision. Recent orders as to the submission of proposals, estimates, &c., will, it is hoped, obviate this for the future.

Our total expenditure on plantations up to the end of 1874, has been Rs 5,07,400. This includes Rs. 94,000, purchase money of land at Nilambúr, much of which contains valuable indigenous forest, but no charge for interest, rent of land, percentage of general supervision, &c., which should properly be added to ascertain the exact financial status. The receipts have been Rs 1,18,824. By far the greater proportion of both expenditure and receipts is on account of Nilambúr (expenditure Rs. 3,03,607, receipts Rs. 96,378), most of the other plantations being comparatively young and immature.

The timber plantations, excluding the fine eucalypti plantations on the Nilgiris for the reason already given, are confined to two descriptions, teak and sandalwood, the former in Nilambúr, South Canara, and Mudumallay, and the latter in the Coimbatore and Nilgiri district.

The teak plantations of Nilambúr have acquired a world-wide celebrity under the able management of Mr. Ferguson. They may be said to have commenced in 1845 (previous planting having been experimental), and are thus 30 years old, the annual rate of extension having averaged 100 acres.

Captain Seaton, Deputy Conservator of Forests in British Burmah, wrote an excellent report of them after inspection in 1868, which is on record; and the administration report of the Department for 1872-73 contains further interesting information from Mr. Athol Macgregor, then Collector of Malabar, who has since been requested to prepare a full report for the information of the Government of India. As Mr. Macgregor has since left the district, it is probable that this important work will have to be undertaken by an officer of the department; meanwhile Mr. Macgregor kindly promised to furnish me with a brief memorandum on the subject which has unfortunately not come to hand. I must, therefore, merely refer briefly to the information at my command here, and to the accompanying map* and valuation of the plantations up to 1870, prepared by Mr. Stanbrough, the Acting Deputy Conservator, who was in charge during Mr. Ferguson's recent furlough to Europe.

The total area of the Nilambúr Forest division is 19,000 acres, of which 4,300 are purchased outright, and 14,700 on perpetual lease deeds. The only private right is that of a temple which is allowed 100 trees every 20 years. Of this area 3,060 acres had been planted with Teak and 3 acres with Sappan up to 31st December 1873. The indigenous forest remains, and is divided into ten blocks; it is for the most part very poor, the prevailing descriptions of trees being *Inga Xylocarpa* and *Lagerstræmia*, with here and there some *Dalbergia latifolia*. There are some 80,000 saplings of the latter interspersed throughout the plantations, which Mr. Ferguson is carefully conserving. The receipts from thinning and sales of timber felled on the area to be planted average Rs. 20,000 per annum, and the disbursements are about the same; in 1873-74, the former were Rs. 24,300 and the latter Rs. 32,000, which included pay and allowances of a probationary assistant attached to the plantation to learn the work. The whole area has recently been surveyed by the Revenue Survey Department, whose maps I exhibit, and Mr. Stanbrough's valuation, which is professedly a mere estimate, makes the present value of the standing crop in the plantation 15 lakhs of rupees, the estimated value per acre varying from Rs. 1,700 in the plantation of 1845, to Rs. 168 for that of the season 1869. Mr. Stanbrough takes exceedingly low rates for the wood, and assuming that his calculations of cubical contents are accurate, his estimates may, I think, be accepted as within the actual value. This will give some idea of the very valuable property which we possess and are acquiring year by year in these teak plantations, not only from a financial point of view but as a reserve supply of teak timber for future requirements. I may mention that Colonel Pearson estimated the value of the plantations when mature at, I think, 2 millions sterling, when their extent was considerably less than it is now.

The South Kanara teak plantation at Parapa extends over only 85 acres, though there is much indigenous teak forest in the vicinity which has been conserved, planted up, pruned, &c. The growth cannot compare with that of Nilambúr, but considering the small expenditure (Rs. 7,231) I do not doubt that the plantation will prove remunerative. There are unfortunately doubts whether under recent orders of the Madras Government the whole tract will not be claimed by private individuals, in which case we may have to give compensation for what has been in our hands for years.

The Mudumallay teak plantations, formed by Colonel (now Major-General) Morgan, for many years Deputy Conservator in charge of that range, are 80 acres in extent, and the growth has been fair, excepting in one portion near Mudumallay itself, where operations have been put a stop to. The expenditure has, however, been very high compared with Nilambúr, having been Rs 20,047, or Rs. 250 per acre, against Rs. 100 per acre in Nilambúr. The difference will appear still greater when it is borne in mind that we had to buy the land at Nilambúr, and not at Mudumallay. I question the expediency of planting at all in the midst of a fine natural

* The map shews only a portion of the plantations herein referred to.

teak forest with high rates of labour, no water-carriage, &c., and I have recently suggested that the planting cease when we have 100 acres, and our attention be devoted to natural reproduction, which can, I think, be easily and economically effected.

The sandalwood plantations in the Coimbatore and Nilgiri Districts covered 158 acres at the close of 1874, and have been made a success by Colonel Morgan after many experiments and failures. The underplanting *(unterbau)* with Arnotto *(Bixa Orellana)* promises to supply a great want in Indian forestry, as it gives sufficient shade to cover the ground, acts as a nurse to draw up the sandalwood plants, and repays the expenses of planting it by the sale of its fruit, which is used as a dye-stuff and paint. The sandalwood plantations have cost close on Rs. 30,000, or Rs. 200 per acre, and however interesting and instructive they may be, I do not now advocate their extension, but prefer to rely on careful conservation and renovation of indigenous tracts of this valuable tree.

Firewood Plantations.

Of the 2,323 acres classed under this head at the close of 1874, 742 acres are in Cuddapah district, 330 in Bellary (since transferred to local (jungle) conservancy), 880 in North Arcot, and 373 in Trichinopoly district.

The Cuddapah plantations, which were commenced in 1868, mainly with the view of supplementing the supply of wood fuel to the district, are four in number, and are for the most part stocked with *Acacia Arabica* and *A. amara*, *Albizzia Lebbek*, *Melia Azadirachta* with *Casuarina equisetifolia* in sandy places. They have been fairly successful, considering the nature of the soil, which is, as a rule, poor, and the climate of the district, with a very low average rainfall.

The expenditure has been Rs. 35,000 in round numbers, or Rs. 47 per acre; but this does not include interest or percentage of supervision charges, which would, probably, raise the cost to Rs. 100 per acre before the trees are fit to fell. Taking the yield at 40 tons per acre (a very moderate estimate), we can always command Rs. 6 per ton from the Railway Company, which would recoup our outlay with nearly 150 per cent. profit from the first crop, while most of the trees will grow again freely from the stool.

The above remarks apply equally to the Bellary plantation of 330 acres at Gooty, although it is inferior to those in Cuddapah, owing to the soil being in many places highly charged with soda. As this was the only imperial conservancy work in the Bellary district, and we could not well spare an officer to supervise it, Government have recently, at my suggestion, transferred it to the immediate charge of the Revenue Department, and it will, therefore, be struck off our list of imperial plantations in the next return.

The firewood plantations in Trichinopoly were commenced in 1871; but most of the planting has been quite recent: more than half the total area of 373 acres has been planted out in the latter half of 1874. The prevailing species are *Acacia arabica*, *A. leucophlæa*, *Albizzia Lebbek*, *Inga dulcis* and *Cassia Florida* with some *Casuarina* in sandy tracts. The peculiar feature with regard to these plantations is their situation, which is in what are known as the *Padugay* lands on the banks of the Cauvery river. The Padugays are belts of alluvial soil of varying breadth, betwixt the normal or natural river bank and an artificial bund thrown up to restrain the flood-waters from overflowing and destroying the neighbouring cultivation. Up to 1870 they were, for the most part, waste covered with a natural growth of scrub, and under the charge of the Public Works Department. It was considered advisable not to allow them to pass into the hands of private individuals who might make use of them in a manner inimical to the river conservancy, and the trees and shrubs were found more or less useful by the Public Works Department officers in constructing temporary dams and weirs at certain seasons to regulate the supply of water in the irrigation channels. In 1870 the Public Works Department agreed to hand them over to our Department, for planting purposes, reserving a belt on the river and channel banks on which to plant nanul for conservancy purposes and the right of supplying themselves with such brushwood, leaves, &c., as might be required from time to time for the temporary dams.

It has since transpired that the subordinates of the Public Works Department permitted, doubtless for a consideration, the inhabitants of adjoining villages to graze their cattle in the Padugays, and as our planting has progressed their exclusion has formed the subject of much complaint. The Madras Government, in recent orders on the subject, whilst affirming the *right* of the State to these lands, takes a liberal view of the *privileges* formerly enjoyed by the villagers, and directs that the Padugays be, in future, only planted when not absolutely required for pasture, or when they cannot be cultivated with food-grains to advantage. The whole question is forming the subject of enquiry by the Collector and the forest officer of the district, and we shall probably secure a sufficient proportion of the available area for our purpose, which aims at planting up 1,000 acres in this district with fast-growing trees to meet the demand for wood-fuel by the South India Railway and local communities.

With a rich soil, facilities for irrigation, and partial flooding at certain seasons, the growth of the several Acacias and of the *Inga dulcis* has been wonderful, and had the plantations been carefully attended to, rapidly opened out and not burthened by a number of extraneous charges for some years after I selected the sites in 1870-71, they would, I am confident, ere this, have been a brilliant success, both from the cultural and from the financial point of view.

As it is, though the expenditure has been heavy,—Rs. 23,000, or Rs. 61 per acre, and will probably reach Rs. 200 per acre before we get our first crop,—I have no doubt of their ultimate success, if operations are carefully and economically carried on, as they have been recently under Mr. Hudfield, who planted 188 acres during the second half of 1874, and spent under Rs. 4,000 including pay of establishment and up-keep of the area formerly planted.

The Collector of the district bears testimony to the satisfactory result in the following terms:—

"I am happy in the belief that real progress is being made under Mr. Hudfield's assiduous care, and that in course of time the Paduguys will give much more advantageous returns in various ways than they would have done under any other system of treatment."

The first crop of *Acacia arabica* and *Inga dulcis* sown in 1871 will probably be taken during next year from a small area, and afford valuable data as to yield. Meanwhile, there is much thinning required in the older portions, the trees having, in many places, formed an impenetrable thicket. The receipts from this source and sale of brushwood have been Rs. 1,800 up to the end of 1874.

The Casuarina plantations of North Arcot have a planted area of 984 acres, the expenditure on which has been Rs. 31,000 and receipts Rs. 2,000 up to end of 1874. The oldest plantation (Trivellum) was commenced in 1868, and is being felled and replanted during the current year. It was originally formed by the Revenue Department as a local plantation, and the trees were planted too far apart, as if for a tope; we find, therefore, only 250 to the acre in the older portions. The forest officer, Mr. Sheffield, in a recent report, sets the outlay up to the end of the tenth year at Rs. 40 per acre, including 30 per cent. for supervision, but no charge for land rent; he sets the receipts from loppings and thinnings against the charge for interest, and estimates the yield from the 250 trees at end of the tenth year at a little over 22 tons of engine fuel, equal to Rs. 132, against an expenditure of Rs. 40 as above. The Board of Revenue, in paragraphs 30—32 of their Proceedings No. 1030, dated 26th April of the present year, give some interesting and carefully worked out data as to the estimated rate of growth, yield, cost, and financial results of the Casuarina plantations based on reports by forest officers in North and South Arcot.

According to the former, 100 acres cost Rs. 6,549 up to the end of the eighth year, including all charges (supervision, land rent, and interest at 4 cent. per annum), and should then contain 5,000 trees, and yield 4,000 tons of engine fuel valued at Rs. 24,000, from which charges for felling, carting, and sawing into billets would have to be deducted.

The South Arcot forest officer (Mr. Wooldridge) spends more money in the beginning, brings a larger proportion of trees to maturity, and gets a larger yield in a shorter time. His charges, including the items specified above, amount to Rs. 10,789 at the end of the sixth year, when the yield would be, according to the results of actual experiments made by him, 5,450 tons of dry engine fuel, equal to Rs. 32,700 per 100 acres, less the charges for felling, carting, and sawing.

It will be observed that neither of these estimates takes any account of the receipts from thinnings, nor of the sale of the best-grown trees as timber, and branches and roots as firewood for the local market. These would be by no means inconsiderable. A most important point in the growth of Casuarina has, however, still to be noticed, *viz.*, that it will grow freely from the stool, at least in the vicinity of the sea, if cut over when six to eight years old, and will yield a second crop of nearly equal weight after seven years more. The truth of this important fact has been fully established by the result of observations and experiments in the South Arcot plantations near the sea shore, and if it can be proved equally true on a large scale, and further inland, the financial prospects of our Casuarina plantations appear very bright.

Planting is being gradually extended in North Arcot; and in South Arcot we have recently taken over charge of large areas, a small proportion of which are planted up from the local or jungle conservancy in which planting operations will be systematically prosecuted year by year as funds are made available. The South Arcot plantations not having been imperial at the close of 1874, their area is not included in the statement which accompanies this paper (see appendix). I consider this Casuarina planting a most important and beneficial work, for not only does it produce a supply of excellent wood for posts, engine, and domestic fuel, &c., in places where there are, as a rule, no indigenous jungles, but it does so from sandy soil on the sea-shore and river banks, and channels where nothing else would grow, but which after successive crops of wood may be sufficiently fertilised and reclaimed to admit of their being brought under the plough and increasing the food-supply of the empire. The amount expended on labour chiefly amongst the poorer classes is also in itself a great boon.

Under mixed plantations those of the Australian Eucalypti and Acacias in the Nilgiris seem alone deserving of notice in this paper, the 106 acres classed under this description in North Arcot presenting no remarkable features. The commencement of Government planting operations on the Nilgiris appears to date from 1859, but the accounts were not separated from those of the indigenous forests in the plateau known as sholas till 1862. In 1869 the charge of the plantations and forests was made over to the Commissioner and transferred from imperial to local, or what is called jungle conservancy, under which they remained till last year, when they reverted to imperial with the sanction of the Government of India, and, with the forests of the Mudunmullay and Seegore ranges which are included in the Nilgiri district, were established a separate forest division. During the jungle conservancy interregnum much progress was made in planting the Australian Eucalypti and Acacias, and the planted area rose from under 200 acres to 926, at which it stood at the commencement of this season. Great credit is due to Major Jago, now Deputy Conservator of the Division, for this result. I have been daily expecting a paper from him on the subject giving some interesting and valuable information as to rate of growth, &c., but unfortunately it has not arrived, and I must, therefore, rely on a few notes I have with me.

There are 19 plantations, of which 13 are in the vicinity of Ootacamund and 6 near Coonoor, the aggregate area being, as stated above, 926 acres, the expenditure on which has been Rs. 39,000, and receipts from thinnings Rs 21,500, of which Rs 18,000 have been realised since 1869 When we recollect that the oldest plantation is not yet 15 years old, this result must be regarded as highly satisfactory and encouraging The growth of the eucalyptus, especially of the variety known as the blue gum, is indeed marvellous, averaging 1 foot per month or 12 feet per annum during the first few years There is a plantation of 60 acres of *Eucalyptus globulus*, mixed with a little *E marginata*, near Coonoor, known as Rallia, which I think, may challenge comparison with any I have ever seen in Europe or India, and will certainly well repay a visit It was planted in 1869-70, and is therefore now just five years old The trees planted at 6 feet apart average 35 feet high and 8 inches in circumference (I write from memory), and the whole plantation is even and well grown A preliminary thinning has been found necessary this year, and, if I mistake not, Major Jago told me that the proceeds would fully cover one-fourth of the total expenditure, though the thinning will be very light and the saplings necessarily comparatively of little value The system of rearing the eucalypti from seed has been much simplified, and the cost greatly reduced of late years under Forester Newman and Major Jago, and it is proposed to plant up 100 to 200 acres annually, to replace the sholas cleared for firewood supply of the stations and extension of tea and coffee cultivation The thinnings yield excellent poles and firewood, and the timber of the eucalypti and *A Melanoxylon* is found to be excellent A considerable quantity of the latter from private plantations has lately been utilised by the Ootacamund Municipality It suffers so much unfortunately from the parasites, the deleterious results of which have been fully described in a brochure by Dr Bidie, that we have been obliged most reluctantly to forbid its being planted for the future

The silver wattle (*A dealbata*) is now a perfect weed in Ootacamund, and it is matter for regret that its planting was not restricted to some distance from the station It yields an excellent firewood, and its growth under coppice treatment is truly wonderful, as a block will yield a good crop every 4 or 5 years With this very brief and necessarily imperfect notice, I must conclude my remarks on the plantations of Australian trees in the Nilgiris, the introduction and naturalisation of which species form a well-marked feature in Indian forestry

It remains now only to allude to the class of plantations called experimental (204⅝ acres). Of these, 15 acres in Kurnool have been given up this year, 8¼ acres in South Arcot are mere topes generally adjoining our timber yards, in which interesting and, in some cases, instructive experiments have been carried on with regard to the growth of several descriptions of indigenous and exotic trees, 104⅞ acres in Madura consist chiefly of an experiment in broadcast sowing of babool, which, I fear, is a failure, about 5 acres of Australian trees on the Pulney hills, and a successful experiment in teak planting at the foot of the Pulney hills This plantation will be extended to at least 100 acres and removed from the experimental class Seventeen acres in the Anamally Division are small teak plantations, which are not to be extended for the reasons already given in this paper, and 9½ acres in Salem are experiments in growing indigenous trees, chiefly sandal, which will also probably not be continued for similar reasons.

There is, therefore, only the 50-acre plantation, already referred to, of *Pterocarpus santalinus* at Codúr in the Cuddapah District, which deserves some notice.

The planting of this valuable tree, yielding the dye-wood known as red wood or red sanders in commerce, may be said to have commenced in 1865, previous experiments having resulted in failure Mr Yarde, the present Deputy Conservator of the district, first discovered how to grow it, and I annex his memorandum on the subject, which I have had printed and circulated to the officers of the Department —

System pursued in Red Sanders planting by H. H YARDE, *Deputy Conservator of Forests*

The seeds are gathered in May and sown in July, in small beds about eight feet square, prepared adjacent to where water is to be had

The seeds are thrust into the light soil perpendicularly, or at an inclination, and about an inch deep (just sufficient to cover the winged seed) From 700 to 800 seeds may be put into the nursery beds of the above-mentioned dimensions, and watered every second evening by a watering-can

Seeds soaked for a night in cold water germinate in 20 to 25 days, while those unsoaked take from 30 to 35

After germination has taken place, the beds must be moderately watered by a picotta or other means, with small communicating or distribution channels made between the beds During the first six months particular care in watering is very necessary Too much water proves equally destructive as none at all The condition of the soil where planted must be the best guide, as they seem only to inhabit the country where the rainfall is small.

The leading shoot at six months has a tendency to drop from the top weight of leaves, and should be supported with a forked stick, which is sufficient to straighten the stem The nursery must be kept free from weeds, and when the plants in the nursery are about six months old, they may be safely transferred to wicker or bamboo baskets, which must be done during the rain. They must be carefully removed with pointed instruments, so that their tap-roots are not injured or broken The wicker baskets with the plants should be placed in a shady spot and watered every second or third day, and when it is perceived that the roots have taken firm hold, and the plants quite revived, bury the baskets in pits 1′ × 1′ × 2′ at about five or six feet apart, and water till the rains set in

During the time the plants are in the nursery, as a protection from the sun, I always found Peruvian cotton, planted near or around, very beneficial Of course any shade will suit the purpose required

The plantation is now in very good order, contains some 21,000 trees, of which 20,000 or 400 to the acre may be said to be Red Sanders, and the remainder, *Cassia Florida* and *Melia Azadirachta*, planted experimentally, or as nurses The expenditure has been upwards of Rs 5,000 up to end of 1874, being a little over Rs 4 per tree, but this includes the cost of the fruitless experiments before Mr Yarde took charge, which will not recur

The total expenditure on plantations in the Madras Presidency up to 31st December 1874 has been Rs 5,07,400, say 5 lakhs of rupees, and the receipts Rs 1,18,824, or one lakh and nineteen thousand, a considerable proportion of which is, however, derived from the clearing of natural forest for planting at Nilambúr

II.—Firewood Reserves

The formation of "*firewood reserves*" in the Madras Presidency commenced in the year 1866, when the Hon'ble A Arbuthnot, then Collector and Magistrate of the Salem district, and now a member of the Madras Board of Revenue, enclosed some small tracts from jungle conservancy funds, and drew my attention, as forest officer of his district, to the advisability of reserving and enclosing considerable areas in the vicinity of the Madras Railway, mainly with the object of securing and maintaining a supply of wood fuel for the use of its locomotives

On this suggestion, the reserves known as A, B, C, D, and E, with an approximate area of 5,000 acres, were reserved and enclosed by a ditch and earth bank topped with aloes in 1866 and 1867, in which latter year the Baulpilly reserve, No 1, in the Cuddapah district, with an estimated area of 1,000 acres, was also formed These tracts were then, and until recently, known as "railway fuel reserves," and are so styled in the Conservator's reports, but the designation has recently been altered to the more appropriate one of "firewood reserves," the produce of which will be available for the local as well as railway supply

By the last returns, submitted for the half year ending 31st December 1874, we have now upwards of a hundred thousand acres (1,01,202½) classed as "firewood reserves" in the several railway districts, where the consumption has, of course, been greatest, and measures of conservancy are most necessary Of this area, however, a large proportion, notably an estimated extent of 40,000 acres in South Arcot, is "*open reserve*," *i. e*, unfenced or not enclosed in a permanent manner, small portions merely being taken up year by year, enclosed by a temporary thorn fence to exclude cattle until natural reproduction, aided by dibbling in of seed, and, in some cases, planting out of seedlings, re-covers the ground.

This system of "open reserves" has, so far, proved successful, and recommends itself on account of the small expenditure involved, and reducing the interference with the privileges of the neighbouring villages as regards grazing to a minimum, as cattle are permitted to graze in all but the temporarily enclosed blocks, goats only being excluded Great care is, however, necessary on the part of the forest employés to prevent such tracts ceasing to be reserves at all except in name, the more so that many are not yet surveyed and mapped, a work which it is urgently necessary should not longer be deferred

Too little has hitherto been done with regard to ascertaining the yield per acre, the proportion of the whole area stocked, half stocked, or bare, the rate of growth, &c, but the attention of the forest officers has recently been called to those important points, without a proper knowledge of which we are working in the dark

The yield per acre necessarily varies much according to situation and description of the jungle, rain-fall, &c, and our estimates of this and the stocking are at present too vague to admit of my giving any data which might be considered *really* reliable I can only state the general results of estimates framed during the past year, and of experimental clearings of limited areas

The area stocked is now estimated by the district forest officers at 41,586¼ acres, while 55,888 acres are entered as "half stocked," and only 3,728 acres, or only 3¾ per cent of the whole, as bare. I doubt, however, the accuracy of those estimates, and have enjoined on forest officers the necessity of more careful stock-taking by means of personal observation, bare spaces being entered as O, and fully stocked by 5, in their note books I have no doubt that by this means we shall eventually arrive at tolerably correct conclusions so soon as the reserves are surveyed and mapped, although, of course, the state of our crop or growing stock will constantly be changing

As regards the average yield per acre, some very interesting experimental clearings were recently made in the Salem district in the oldest of our firewood reserves, and the results were favourable beyond expectation Unfortunately, some errors in calculation of areas cleared, which were detected on re-measurement, have vitiated the whole, and rendered new and more extensive experiments in that and other districts necessary before we can estimate our yield with any approach to accuracy I can now only state that the yield of an experimental clearing in North Arcot has been 8 tons per acre, that the yield in Salem will probably be 10 to 12 tons per acre, whilst in the moist jungles of Wallaai, in Malabar, one acre has yielded as much as 17 tons of engine firewood The "length of rotation" or revolution is also quite unsettled, and can only be ascertained by careful experiments and statistical notes extending over the next 10 or 15 years So far as we may hazard an opinion, I should say that from 7 to 10 years on the western coast (*i. e*, with the influence of the south-west monsoon), and from 10 to 15 in the central and eastern districts, will suffice for the reproduction either from seed or coppice growth of firewood fit for use in the locomotives, *i. e*, of a minimum diameter of 3" This would represent a yield of say 1½ tons per acre per annum in the former and ¾ ton in the latter, which would be satisfactory

I proceed to give some information as to the prevailing description of tree in the reserves of each district, the financial position, &c.

The Cuddapah reserves, with an estimated area of 16,830 acres, are very favourably situated on either side of the railway line, and are all either fully fenced in, or that work is in progress. The prevailing trees are *Mimusops hexandra* and *Elengi*, *Strychnos Nux-vomica*, *Conocarpus latifolia*, *Pterocarpus santalinus* and *Vatica Tumbagaia*. The two latter can scarcely be classed as firewood trees, as they are valuable as timber, and the trunk and roots of the former form the valuable Red Sanders dye-wood of commerce.

The expenditure from the commencement has been Rs. 10,873. There has been no felling nor revenue from the reserves, portions of which were worked by contractors for the railway companies before being reserved and enclosed.

North Arcot.—There is only one closed reserve in this district, known as Mamandar, with an estimated area of 2,560 acres, which has cost Rs. 2,654 to enclose and conserve since its formation in 1871. The prevailing description of trees is the same as in the adjoining district of Cuddapah, and there has as yet been no felling beyond the experimental clearing already referred to, which was also made to serve the purpose of inspection paths. There has been great difficulty in this district in securing the requisite area of wood reserve (estimated at 7,000 acres) for the railway supply, owing to objections on the part of villagers, and we are still 4,500 acres short.

The Mamandar reserve includes a hill slope close to the line of railway, and will, it is hoped, prove very useful and remunerative hereafter.

South Arcot.—In this district we have an estimated area of 40,550 acres as *open* firewood reserves, selected in 1869 mainly with a view to the supply of the South India Railway extension. They are rather remote from the line (10 to 15 miles), but there is no indigenous jungle nearer. Much has been done in the shape of encouraging and stimulating natural reproduction, and some 88,000 trees are reported established from nurseries. The prevailing descriptions are *Acacia amara*, *Albizzia Lebbek*, and *Cassia Florida*.

The expenditure has been Rs. 8,225 and receipts Rs. 529, realized from sale of dead wood, minor products, &c., no felling on the reserved areas having taken place.

Trichinopoly.—There are five firewood reserves in this district with an area estimated at 2,721 acres, but which is really much greater. The prevailing tree is the umbrella thorn *(Acacia planifrons)*, but the jungles are, on the whole, very poorly stocked and interspersed with the tree spurge *(Euphorbia Tirucalli)*; hence we must rely mainly on our firewood plantations for the supply of engine wood. The expenditure has been Rs. 4,768 and receipts Rs. 750.

Tinnevelly.—In the southern district the extension of the South India Railway runs so far away from the indigenous forests on the Western Ghâts that, in adopting measures for securing its supply, we have almost exclusively devoted our attention to the conservation and growth of the Babul (*Acacia arabica*) and umbrella thorn (*Acacia planifrons*) in the shallow beds of rain-fed tanks and on the sides of irrigation channels.

In this manner we have secured an estimated area of 2,000 acres classed as half stocked, the expenditure on which has been Rs. 7,055 and receipts Rs. 103 from the commencement, (1872).

The growth is excellent and good natural reproduction or coppice growth certain, but there have been and are difficulties with regard to the rights of ryots, and some of the Department Public Works Officers consider that the growth is detrimental to the tanks. On the whole, however, the experiment has been successful, though it is doubtful whether it will be long continued except for local requirements.

One lakh of trees averaging a quarter of a ton each are reported ready to fell so soon as the railway is open, which it is hoped will be this year. Some of the tanks have been fenced in.

Madura.—The firewood reserves selected in this district have never been properly constituted nor conserved, and are, therefore, omitted in our reports for the present.

Coimbatore.—The area reserved in this district is estimated at 13,170 acres, chiefly open reserve.

Much money has been spent to little purpose on the Sholakurry, formerly known as Wallar reserve of 1,000 acres fenced in. From its situation just within the limits of the south-west monsoon great results were expected from this reserve, which have never been realised, nor do I think that they are likely to be nearly so good as from those recently purchased and constituted in the adjoining district of Malabar, where the rain-fall is much greater. A fair yield may, however, I think, be reckoned on, and the expenditure has now been reduced to a minimum. The Coimbatore firewood reserves have cost up to date Rs. 14,826, whilst the receipts have been Rs. 629.

Salem.—In Salem we have eleven reserves, with an estimated area of 19,369 acres, classed as fuel reserve, partly *open* and partly *closed*, the whole area being classed as half stocked. The expenditure, commencing, as has been stated, in 1866, has been Rs. 17,827, with receipts from dead wood, &c., amounting to Rs. 683. The prevailing tree is the *Acacia amara*, which ranks high as engine fuel. The chief expenditure has been on fencing and planting up in the C reserve which was originally classed as a plantation. No felling has taken place in any of the reserves since their formation beyond the experimental clearings already referred to, and which are being extended. We have hitherto been able to meet the demand from supply tracts outside the reserves, and shall continue to do so as long as possible, although the older trees within the reserved areas will now be felled to ensure coppice growth.

Malabar.—There is one reserve near Palghát in this district consisting of two fine tracts of forest, recently purchased from private proprietors with the sanction of the Government of India, and now known as the Walliar reserve. The limits have been roughly measured and area estimated at 4,000 acres, well stocked with various descriptions of timber and firewood trees, including a large proportion of teak.

The purchase-money was high, upwards of Rs. 40,000, or in round numbers Rs. 10 per acre; but for this we have the exclusive right of proprietorship, and as the experimental clearing of one acre which had been cleared only seven or eight years ago gave 17 tons of engine firewood, I think the purchases favourable, and that these tracts will ere long, under careful conservancy, prove a very valuable State property.

The total amount expended on firewood reserves in the Presidency has been Rs. 1,12,994 up to the end of 1874, whilst the receipts have been Rs. 2,856, but it must be remembered that we have meanwhile been securing a large revenue from the *supply tracts* outside of the reserves, having supplied 22,471 tons from the Districts of Cuddapah, Salem, and North Arcot to the Madras Railway Company.

The financial results of the firewood reserves cannot be arrived at for some years to come, until felling has been carried on and their yield ascertained. The Madras Railway consumed in 1873, 58,719 tons, and the Agent of that Company now estimates his maximum requirements at 78,000 tons per annum.

The South India Railway only consumed 3,500 tons in 1873, but the Agent would now take 51,000 tons per annum if he could get them.

With these facts before us, besides the rapid clearing of all jungle in the vicinity of the railways for cultivation and the ever-increasing demand for firewood and charcoal, we cannot, I think, err in conserving our reserved area and extending its limits, if only to secure a permanent supply for the *local* requirements of the future, when the railway companies will find it necessary to burn Indian or seaborne coal, or patent fuel.

I trust that the foregoing remarks will prove that, whatever may be the generally received idea of Forest Conservancy in Madras, which was, I regret to say, styled the "*terra incognita* of Forestry" at the last Conference, we have not been unmindful of the paramount object of the Department, *viz.*, the preservation and production of timber and wood-fuel; and it is not only my duty but a pleasure to assure you that the Government, which I have the honour to represent at this Conference, have never shown themselves wanting in their efforts in this direction, so long as the rights or privileges of the people are not seriously interfered with, and to express my conviction that if financial considerations of the moment are not allowed to fetter our action, we shall eventually exhibit as good and satisfactory results as may be hoped for in other provinces, perhaps more bountifully supplied than we are with those great requisites of our Department in the present day—rain-fall and money.

This was followed by a discussion on the yield of these plantations. *Mr. Smythies* pointed out that the figures given by Captain Campbell Walker for the *Casuarina* plantation in South Arcot amounted to a yield of 410 cubic feet per acre per annum, which was four times greater than the yield in the best French high forests. *Captain Campbell Walker* allowed that this was high, but the calculations had been made independently by two officers, and he had every reason to believe that they were accurate. *Mr. Brandis* said that he was not surprised at these figures. He firmly believed that the yield of well-stocked and well-managed plantations or forests in many parts of India would greatly exceed our expectations. A very high yield could not, of course, be expected in the dry and arid regions of India, except when irrigation was available. The future yield of the *Changa Manga* plantation in the Punjab, which was irrigated from the Bari Doab Canal, had been estimated by Mr. Ribbentrop as high as 240 cubic feet per acre. He himself (Mr. Brandis) had not in former years been inclined to assent to this estimate, but he was now informed that officers competent to judge, held that, with a regular supply of water, 240 cubic feet per acre per annum might be attained. He would suggest that we should abandon the term "fuel plantations," for most plantations made for the purpose of providing fuel in the first instance would yield a good proportion of timber and small building wood. In the Punjab plantations certainly he felt convinced that, notwithstanding Dr. Schlich's warning, it would be found profitable to reserve standard trees, and to sell a large portion of the wood produced as timber which would fetch three or four times the price of fuel.

Captain Campbell Walker replied that the term "fuel plantation" was especially used, because in the first instance they were made for the supply of railway fuel; and *Captain Van Someren* said that in Mysore the plantations were called "fuel," but much of the produce would probably be sold as timber.

APPEN

List showing the number and estimated value of trees remaining

Name of Plantation.	Year of plantation.	Average planted.	Average number of trees remaining per acre.	AVERAGE NUMBER, HEIGHT, CIRCUMFERENCE (6 FEET FROM GROUND) CUBICAL CONTENTS AND VALUE OF TREES IN EACH PLANTATION.																				
				1st Class.					2nd Class.				3rd Class				4th Class							
				Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 12 annas per cubic foot.	Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 12 annas per cubic foot.	Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 4 rupees per tree.	Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 1 rupee per tree.
Eddacode	1844	37½	120	24	70'-80'	41''4	650½	487½	54	60'-65'	30''0	660½	510	42	50'-60'	25''7	961½	168	...	...	...	...	...
Ditto	1845	28	160	20	...	48''0	731½	548½	98	...	32''3	1,230	990	62		26''7	647½	208	...	...	...	...	
Ditto	1846	44½	130	...	...	..	...	...	80	...	38''4	1,803½	976½	50	.	24''3	326½	200	...		..	...	...
Ditto ...	1847	54½	143	...	...		...	.	46	...	34''0	781	585½	92	...	24'' 7	633½	328	13	60'-65'	17''4	33	13
Ditto	1848	84½	190	...		...	.	...	64	...	32''4	1,094	788	56	...	24'' 7	439½	224		. .	...	...	...
Ditto	1849	44½	140	...	.	...	...	...	52	...	31''5	770	577½	84		23''3	576½	336	4	...	17''0	14½	4
Ditto	1850	49½	164	.	...	...	...	...	54	...	31'' 9	810	607½	94		24'' 1	726½	376	36	...	17''9	192	63
Ditto ...	1851	147½	180	...	...	...	.	...	60	...	31''1	926½	619½	98	..	23''9	742	384	24	...	18'' 0	96	24
Ditto	1852	36	230	...	...	...	...	...	...	...	...	...	...	60	...	23'' 0	551	320	90	...	18''5	333	99
Ditto	1853	39½	280	..	...	...	...	...	...	...	...	...	...	56	...	22'' 3	385½	224	90	...	18''4	333	90
Ditto	1861	96	340	...	...	...	...	...	...	...	...	...	...	110	...	21''0	672	440	95	...	18'' 3	361	95
Ditto	1862	50	396	...	...	...	...	...	...	...	...	...	...	80	..	20'' 9	498½	320	96		18''0	344½	96
Arivacode ..	1843	31	150	...	...	...	...	..	32	...	34''9	535½	416½	60	...	22'' 3	516½	240	42	...	19'' 1	178½	42
Ditto	1844	30½	94	76	.	46''3	2,636	1,069½	18	...	34'' 6	316½	237½	...	...	...	...	..		...		...	...
Ditto ...	1847	29½	170	...		.			64	...	33''6	1,136	844½	66	...	25''8	568½	264	24	...	18''5	102	24
Ditto	1848	83½	200		...	...	...	...	52	...	33''1	760	585	88	...	26''2	680	352	28	...	18'' 1	119	28
Ditto ...	1852	38½	233	...	...	...	...	...	24	...	32''0	360	270	140	...	23'' 5	904½	560	56	...	18''0	205½	56
Ditto	1853	34½	240	..	...	...	...	...	12	...	31'' 3	165½	123½	112	...	23'' 3	771½	448	96	...	17''6	205	56
Moolath Munna	1844	5	150	...	...	...	...	...	56	...	31''5	84	630	48	...	23'' 7	371	192	32	...	19'' 8	156	32
Ditto ...	1847	34½	150	26	.	39''3	660	495	52	...	30''3	655	491½	14	..	25''9	130½	56	36	...	19''0	163½	36
Ditto ...	1848	16	170	3	...	39'' 0	47½	35½	26	...	32''1	390	292½	86	...	24''1	664½	344	44	...	18'' 8	167½	44
Ditto	1850	16½	160	..	...	...	...	...	48	...	32''1	781	585½	72	.	23''7	490	288	40		18''9	170½	40
Ditto	1853	7½	214	16	..	44'' 3	491½	368½	12	...	33''5	180	135	65	...	22'' 6	415½	240	56	..	18''0	206½	56
Ditto ...	1853	12½	280	...	...	...	..	...	...	...	...	..		45	...	21''6	275	180	69	...	18''0	227½	63
Willonjary.. ...	1845	38½	164	...	.	...	...	...	28		35''8	630½	307½	100	...	22'' 0	861	400	36	.	17''3	133	36
Ditto ...	1846	65½	130	9	...	40''1	900	150	28	...	32''0	456½	341½	60	...	24'' 6	468½	240	24	...	17''3	88	24
Ditto	1849	90	178	...	...	...	...	...	15	...	32''1	226	169½	83	..	22 ''3	564½	328	56	...	17''5	206	56
Ditto	1850	66½	176	...	...	...	...	...	22	...	33''0	288	288½	106	...	22''1	793½	420	42	...	18''4	178½	42
Ditto	1858	42½	400	...	...	...	...	...	...	..	...	..	...	63	...	22''1	434	252	77	...	17'' 4	269½	77
Ditto	1859	89½	350	...	...	...	...	...	...	...	...	...	...	50	...	22'' 6	344½	200	94	...	17'' 3	344½	94
Panangode	1854	92½	306	...	...	...	...	...	...	...	...	...	...	78	...	22''1	446	292	81	..	18'' 0	297	81
Ditto	1855	100½	200	...	...	...	...	...	...	...	...	...	...	44	...	22'' 1	268½	176	60		17''0	220	60
Ditto	1856	79½	366	...	...	...	...	...	...	...	...	...	...	77	...	22''0	470	308	133	...	18'' 0	467	133
Ditto	1863	61½	319	...	...	...	...	...	..	...	...	...	...	44	...	22''.1	268½	176	180	...	17'' 5	766	180
Walloovashary ...	1844	121½	415	...	...	...	...	...	...	...	...	...	...	16	...	20''5	98½	64	60	...	17'' 4	265	60
Ditto	1865	56½	577	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	17	...	17''1	73½	17
Ditto ...	1866	126½	580	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ditto ...	1867	119½	760	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Ditto ...	1869	145	734	...	...	...	...	...	...	...	...	...	...	...	...	.	...	...	...	...	...	...	...
Ditto ...	1869	54	790	...	...	...	...	...	...	...	...	...	...	...	...	...		..	...	...	...	...	...
Total acreage. .	...	2,849½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

NILAMBUR,
1*st June* 1875.

DIX B.

per acre in the Nilambur Plantations from the year 1842 *to* 1869, *inclusive.*

CONTENTS AND VALUE OF TREES REMAINING PER ACRE IN THE NILAMBUR PLANTATIONS.

5TH CLASS.					6TH CLASS.					7TH CLASS.					8TH CLASS.					Estimated value per acre of each plantation.	Estimated value of each plantation.	REMARKS.
Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 12 annas per tree.	Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 8 annas per tree.	Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 2 annas per tree.	Number of trees.	Height.	Circumference 6 feet from ground.	Cubical contents.	Value at 1 anna per tree.			
																				Rs	Rs.	
...	...	...	...	...	...	...	..	...	...	...	...	...	...	...	..	...	...	...	...	1,166½	32,058	The value is estimated at the average rates, the Saplings reaised in the Coast market Teak with quarter girth of 5 inches and upwards. I have included as timber and have estimated the value at 12 annas per cubic foot
...	..	...	..	...	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	1,740½	48,902	
.	...	...	..	...	...	...	...	...	.	...	...	...	...	...	...	..	...	...	...	1,176½	31,755	
...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	.	...	925½	30,453½	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	902	33,834	
..	...	...	...	...	...	.	...	...	..	...	...	...	...	...	...	...	...	...	...	917½	40.828½	
...	...	...	..	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	1,019½	30,405½	
...	...	...	...	...	...	.	...	...	...	...	...	...	...	...	...	...	...	...	...	1,027½	1,51,392½	
53	45-40'	10'-4	154½	41½	25	40'-35'	12'-0	45½	12½	...	...	...	...	...	...	...	...	...	...	462½	16,695	
40	...	10'-2	135	36	36	...	12'-7	120½	45	...	35'	...	...	...	...	...	...	...	...	393	15.621½	
88	..	15'-8	247½	66	54	..	12'-0	75½	27	3	...	8'-0	...	½	...	...	...	...	...	615½	53,191	
204	.	14'-2	378½	220½	120	...	11'-9	165½	60	8	...	7'-9	...	1	...	...	..	...	...	696½	34,775	
16	...	14'-6	37½	13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	710½	23,025½	Thus plantation appears to have been planted at a later date than that given.
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	2,207	67,313½	
16	...	15'-0	37½	13	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	1,144½	33,476	
32	...	15'-0	75½	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	989	31,699½	
12	...	16'-0	33½	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	895	24,457½	
60	...	14'-8	141½	45	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	672½	23,378	
16	...	15'-0	39½	10½	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	864½	4,323½	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1,080½	37,838½	
12	...	12'-0	26½	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	725	11,600	
.	..	...	.	...	...	...	...	...	..	...	...	...	...	...	...	...	...	...	...	918½	15,076½	
42	...	12'-2	99	31½	28	...	12'-3	89½	14	...	...	...	...	...	...	...	...	...	...	945	6,566½	This plantation is interspersed with large trees, which leads me to infer that it was originally planted with teak at some earlier period than that given; some portion of it was, however, evidently planted in 1863
108	...	15'-1	247½	78½	63	...	12'-6	91	32½	3	...	9'-6	...	¾	...	...	...	...	...	838½	4,510	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	832½	27,722	
...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	755½	49,107½	
36	...	15'-1	59	18½	...	...	...	...	...	...	..	...	...	...	...	..	...	...	...	571½	51,435	
9	...	15'-0	21½	6½	...	...	...	...	...	...	...	..	...	...	...	..	...	...	.	737½	49,027	
120	...	15'-1	288½	90	96	...	12'-0	137½	49	42	...	9'-8	...	8½	...	...	...	...	...	673½	20,442	
96	...	14'-8	226½	72	92	...	12'-8	130	46	38	...	10'-0	...	4½	...	...	...	...	...	616½	16,585½	
60	...	14'-5	94½	30	12	...	11'-6	13½	6	...	..	...	...	...	...	...	..	...	...	409	37,730½	
48	...	15'-3	141½	36	28	...	12'-8	44½	16	16	...	10'-6	...	3	...	...	...	...	...	200	39,145	About 15 acre of this plantation are devoid of plants: to allow for this defect a deduction of 30 trees has been made from the average number of trees remaining per acre. The defect alluded to is owing to the indifferent soil.
116	...	14'-0	183½	57	28	...	12'-6	81	14	12	...	10'-0	...	1½	.	...	...	...	...	542½	42,990½	
112	.	14'-6	264½	84	88	..	12'-0	123½	44	86	...	9'-7	...	11	...	...	...	...	...	495	40,218½	
72	..	14'-2	177	56½	150	...	12'-9	210½	75	118	...	9'-0	...	14½	...	..	...	...	.	260½	32,842	
80	...	13'-0	166½	60	264	...	12'-8	370½	132	216	...	8'-7	...	27	...	...	...	...	...	288	13,334	
...	...	...	...	..	432	...	12' 4	606	216	148	..	9'-2	.	18½	...	.	...	...	...	264½	30,138½	
...	...	...	...	...	330		12'-1	490½	175	308	...	9'-2	...	49	117		5'-7	..	...	321½	26,439½	
...	...	...	...	...	512	...	11'-6	718	256	84	...	9'-0	...	10½	128	...	5'-7	..	...	274½	32,903½	
...	.	...		.	240	...	12'-0	336½	120	124	..	9'-2	...	26	333	...	5'-6	...		166	9,073	
...	...	...	...	...	...	...	...	...	...	...	...	...	...	..	...	...	...	...	...	...	14,91,007½	

A. W. STANBROUGH,
Acting Deputy Conservator of Forests.

Preliminary Working Plans.

Tuesday, October 12th

Dr. Schlich then commenced his paper on the above subject with an explanation of the terms "normal forest," "normal age classes," and "normal annual yield;" this occupied the remainder of the afternoon, and on the following morning *Dr. Schlich* read the second part of his paper.

The preparation of detailed working plans for all Indian State forests will require a great many years. It is evident that we cannot manage the property entrusted to us for so long a time without some sort of a plan; hence it is our duty to compile and work according to the provisions of what have been called "preliminary working plans." These should guide us until we can manage to draw up regular working plans.

I may say that all Indian State forests are in an abnormal state, and consequently the main object of working plans is to lead these forests over into the normal state, that is to say, to establish the normal age classes, normal increase and normal growing stock as far and as fast as the demands on the forests permit us.

The demand on our forests for some particular kinds of produce is generally greater than can be satisfied, whereas for others there is no demand at all, or at any rate it is below what is being produced. Hence we are labouring under particular difficulties, when laying out plans to bring the forests up to the normal condition. However, the difficulties will have to be faced, and I therefore proceed to explain my views regarding the method of drawing up preliminary working plans.

The area of the forests is very large and the staff of officers extremely small. In order to bring all forests within the next few years under the operation of working plans, the latter must be of a simple nature. The following proposals are so arranged that an officer fairly skilled in the work can prepare in one season a preliminary working plan for a forest area of between 100 and 200 square miles in the plains, or an area in the hills reduced in proportion to the difficulties of the country. This point should be kept in view in judging of my proposals. I should arrange the subjects to be dealt with according to the order in the appended list, on which I now offer the following remarks:—

Preliminary Working Plans.

1.—Duration of working plan.
2.—Extent of working circle.
3.—General description of working circle:
- *a.*—Situation and boundaries.
- *b.*—Topographical description.
- *c.*—Climate.
- *d.*—General character of forest growth and enumeration of products.
- *e.*—Population in and around the working circle, and statement of existing rights and privileges.
- *f.*—Depôts, markets, lines of export.

4.—Formation of compartments and blocks.
5.—Detailed description of each compartment:
- *a.*—Area.
- *b.*—Growing stock of material.
- *c.*—Notes on past management and present condition.

6.—Rate of growth of the principal trees.
7.—Working arrangement:
- *a.*—Calculation of annual yield—
  - 1*st*—High timber forest.
  - 2*nd*—Coppice forest.
  - 3*rd*—Coppice under standards.
- *b.*—Selection of compartments to be worked during the duration of the working plan.
- *c.*—Mode of working, and reproductive measures, with regard to wood, as well as to minor forest produce.

8.—Collection of statistical data.

1.—*Duration of working plan.*

I propose ten years, with the proviso that a revision may be made after five years. To fix five years in the first instance is too short, because it is doubtful whether we can make a new working plan every five years with the present staff.

2.—*Extent of working circle.*

This is a very important question, and one not so easy to answer in all cases, because executive and controlling duties have not as yet been completely separated. As a general rule, I should say that a working circle, or the forests for which one working plan is to be prepared, should not comprise more than one executive charge, and in cases where the executive charges have not as yet been clearly established, I should make a separate working plan for the forests which are likely to comprise one executive charge hereafter. On the other hand, within one

executive charge there may be two or more working plans, if called for by the peculiarities of the Forests.

In some instances it may be necessary to throw, in the first instance, several executive charges together into one working plan, but, whenever practicable, this should be avoided.

3.—*General description of working circle.*

This does not require a special explanation.

4.—*Formation of compartments and blocks.*

It is a very common mistake that the chief reason for dividing a forest into compartments is to separate differently stocked areas. This may be one reason, but the most important point is to facilitate the working and supervision. Hence the smaller the compartments can be made, the better.

On level ground I should establish the compartments by laying out a net-work of roads, which, if possible, should cross each other at right angles. On hilly ground the shape of the compartments depends on the configuration of the country, as the roads must be established in the more accessible parts.

The size of the compartments depends on the mode of working and the net revenue which the forest is capable of yielding. The more valuable a forest is and the larger the returns, the smaller the compartments should be, so as to make the arrangement and protection as complete as possible.

If there are decided differences of soil or vegetation within one compartment, it may be divided into sub-compartments. If the differences of vegetation disappear in course of time, then the sub-compartments will also disappear.

If a forest is of considerable extent, it becomes advisable to divide it into a number of blocks, so that each contains a certain number of compartments. The boundaries of the blocks should be natural division marks, when such exist.

Blocks, compartments, and sub-compartments should always be indicated in the same manner, the most practical in my opinion being the following :—

Blocks by Roman figures.
Compartments by Arabic figures.
Sub-compartments by small letters.

Thus, III, 5, c, would mean block III, compartment 5, sub-compartment c. In addition, blocks should receive names whenever available, and very often it is a help to have names for compartments as well, though not absolutely necessary.

5.—*Detailed description of each compartment.*

This and the following section contain the more immediate data upon which the working arrangements have to be based :—

a.—area.

This will be found by means of a survey, but as that is a matter of time, we shall have to take advantage of existing surveys. For preliminary working plans, existing topographical or revenue survey maps will provide sufficiently accurate data regarding the total area of forests or blocks, and all that we have to do is to mark in the proposed boundaries of the compartments and then to ascertain their areas from the map.

Where no maps at all exist, it will be necessary to compile a sketch map. It is *absolutely* necessary to obtain some idea of the areas, or else the only means of ascertaining the growing stock of material is to measure or count *all* trees. The scale of the map must depend on circumstances.

b.—Growing stock of material.

This I should ascertain by measuring all trees on sample areas, and by ascertaining thus the contents per acre (not per 100 acres), and by calculating the total contents for each compartment or sub-compartment. Whenever practicable, the sample areas should be narrow strips running from one end of the compartment to the other, in other words, linear valuation surveys, which were first introduced by Dr. Brandis in 1856. The breadth surveyed should be 100 feet. The area surveyed should not be less than two per cent. of the total area. I should classify the trees according to girth, because the people of the country are accustomed to it, and I should adopt the classification now in force, *viz.*—

Seedlings	under 1 cubit girth,	under 18″	—I Class.
Saplings	from 1 cubit to 2 cubits girth,	18″ to 3′	—II „
Young trees	„ 2 cubits „ 3 „ „	3′ to 4′ 6″	—III „
Trees	„ 3 „ „ 4 „ „	4′ 6″ to 6	—IV „
Old trees	„ 4 cubits and above „	6′ girth and above	—V „

I should further measure the trees at height of chest of a man, in the case of natives about 4 feet from the ground, and not 6 feet from the ground, as few natives, and for that matter also Europeans, can measure a tree accurately at the latter height.

The survey lines should be equally distributed over the blocks or compartments.

c.—Notes on past management and present condition.

Here every point bearing on the working arrangements should be noted, as condition of forests, growth, whether vigorous or otherwise, blanks, and their extent and situation, how the

compartment appears to have been treated in the past, and preliminary hints as to its future treatment.

The data of this section may be recorded in a tabular form.

6.—Rate of growth of the principal trees.

Unfortunately, not much can be said under this heading. We must try and ascertain the rate of growth by counting and measuring the concentric rings of trees, whenever it has been established that each concentric ring corresponds with one year's growth. Otherwise we must look out for trees of known age, and if such are available, ascertain from them the rate of growth; if that fails, we must try and make an estimate based upon such points as may be available to guide us.

It should be ascertained or estimated what the average age of a tree of 18", 3', 4' 6" and 6' girth is. The following list shows the radius corresponding with each of these girths :—

Girth.	Radius.
18"	2"·86
3'	5 ·73
4' 6"	8" 60
6'	11"·50

7.—Working arrangement.

This will depend on the data enumerated above, and the following remarks should be considered as of a general character only :—

a.—Calculation of annual yield.

1st.—High timber forest.

The first thing to be done is, to fix the age or size at which the trees are to be cut. Assuming that no tree of less than 6 feet girth, measured at height of chest, is to be felled, then the simplest method to ascertain the maximum annual yield is by ascertaining—1*st*, the total number (*s*) of trees of 6 feet girth and upwards; 2*nd*, the number of years (*a*) required to allow an equal number of younger trees to grow up to 6 feet girth and upwards; and 3*rd*, to divide the number of trees (*s*) by the number of years (*a*), thus obtaining the maximum annual yield, $y = \frac{s}{a}$. No doubt this is an extremely rough method, but one quite accurate enough for preliminary working plans, where the data at our disposal are generally so scanty and of such an approximate description that the adoption of a more accurate mode of calculating the maximum annual yield would be simply waste of time.

2ndly.—Coppice.

After fixing the age *(a)* at which the trees are to be cut over, the whole area (*f*) under forest is to be divided by *a*, and the result $\frac{f}{a}$ represents the area to be cut over annually. Thus, it will be observed, the maximum annual yield is expressed by area only. By means of valuation surveys it can be ascertained what the average contents per acre or the total annual yield will amount to. If differences in the productive power of the soil are easily distinguishable, then they may be taken into account by fixing the annual cutting area in the reverse proportion of the quality, but if these differences are not very considerable, they should not be taken notice of in preparing a preliminary working plan.

3rdly.—Coppice under standards.

The system will be precisely the same as in the case of simple coppice.

b.—Selection of compartments to be worked during the duration of the working plan.

The compartments which are comparatively richest in old trees, or in which the increase is smallest, should, as a rule, be selected. If the difference between the compartments is not very great, and if other reasons against it do not exist, then the compartments selected should adjoin each other. *In the case of high timber forest, the area to be operated on should be of such an extent, that the number of trees of the fixed size* (6' *and upwards*) *on it is equal to the maximum yield calculated for the duration of the working plan,—here ten years. From this area all trees of the fixed size* (6' *girth and upwards*) *fit to yield marketable material may be removed during the working plan period.*

This method requires a few explanatory remarks. A more accurate system would no doubt be to cut the annual yield irrespective of area, but, in my opinion, that advantage will be more than outweighed by the following considerations. In the first instance, the valuation surveys made for a preliminary working plan will, as a rule, not be sufficiently complete and accurate to ensure our ascertaining the *exact* amount of growing stock, hence there would always be a danger of our either over-working or under-working the forest. The former would lead us to want of material hereafter, and the latter to waste of material in the forests. *Secondly*, most of the Indian forests contain large numbers of old trees which, though they would appear on our valuation registers, are not fit to yield marketable material; consequently by working only by quantity, we might use up all the good trees of the fixed size in half the time necessary to replace them. It is true, this might be avoided by ascertaining the proportion between marketable and unmarketable trees, but that would be a work of great difficulty and time, and besides individual ideas would have a heavy bearing on this proportion, so that if the officer who makes the valuation survey is not the same who works the forests afterwards, room for great errors would be left.

On the whole, I am therefore of opinion that, although the annual yield is first ascertained according to quantity, it should finally be expressed according to area, the latter to be fixed so as to contain, according to estimate, the maximum annual yield. Whatever marketable trees of the fixed size may be found on the area will be removed, whether their number may come up to the calculated yield or not. In this manner we ensure that our trees of the fixed size will last throughout the period required to replace them, though the annual yield in the several years may differ within moderate limits.

c.—Mode of working, and reproductive measures, with regard to wood, as well as to minor produce.

The decision in this case depends entirely on local circumstances, as the size or age at which the forest produce is to be harvested, then whether the prevailing species of timber are to be favored, or whether other species are to be raised instead; then, again, on the peculiarities of the species, whether reproduction is to be effected by natural or artificial means, or by both combined; then, again, whether minor forest produce is of such importance as to necessitate the management being arranged accordingly. All these points and others should be considered in determining the mode of working and of reproduction.

8.—*Collection of statistical data.*

It will be necessary to collect, while the preliminary working plan is in operation, data upon which a more accurate working plan can be based hereafter. To settle the details of this question would involve more time than is at our disposal at present, and therefore I confine myself to merely mentioning the subject, which should be taken up in another place.

Finally, I present to the Conference a map, illustrating a preliminary working plan lately drawn up by me for the Buxa Forest Reserve in the Dooars, Julpigoree District.

Animated and protracted discussions intervened between the several paragraphs of Dr. Schlich's paper, but it was not found practicable to reproduce them here.

Forest Terminology.

Mr. Smythies then read a paper on Forest Terminology, which appeared in the January number of the "Indian Forester." Most of the terms were discussed by the members present, and some of the more important ones were finally agreed upon; a list of these will also be found in the above-mentioned periodical.

The Tanna Forests.

The seventh and last day's proceedings commenced with *Mr. Gibson's* paper on the Tanna Forests, which, at his own request, is not printed in the proceedings.

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Uses of the Prickly Pear.

Mr. Wallinger read the following paper on the above subject:—

Concerning the Opuntia vulgaris—the prickly pear—as a natural preserver of plants and trees, as a valuable manure, as a fence material, and as a product possessing certain medicinal uses.

The prickly pear, or as it is called in Marathi the Phudeh Nurung, is a cactus very common in the Deccan of the Bombay Presidency, and is classed twelfth in the classification by Linnæus, who named it the Opuntia vulgaris. It is called the Indian fig. This cactus is the hardiest of all the genera of cacti, and on Mount Etna, where forests of it exist, it grows in chinks and crevices in the rocks where there appears scarcely soil enough to contain its roots. A specimen of the plant was taken to the botanical garden at Kew, near Richmond in Surrey, where it is now, amongst many others of the same family, admired as a curious exotic. Attempts have been made and a desire exists, I believe, entirely to destroy this plant. It is, however, judicious to accept as a truth that every created thing has a use in Nature's great and frugal scheme, to which it can be legitimately and indeed profitably applied. The Opuntia vulgaris came to this country from America, and is there met with even on the Rocky Mountains up to 49 degrees of north latitude. Methods are found of using this plant and members of its family in other countries. In North America an Opuntia is used for protection around forts. In the very poorly wooded districts of Chili and Peru the stems of an Opuntia take the place of wood for small beams and door-posts, and in the north of the former country it is used as firewood for copper smelting. In Peru the thorns are cleverly made into needles. In California hedges are made with the Opuntia vulgaris around cultivation. In the West Indies the Opuntia vulgaris is used for feeding pigs, also for hedging, and is there cultivated. In Mexico the Opuntia vulgaris and Opuntia cochinillifera are used for hedging the boundaries of fields, and figure in one of the quarterings of the arms of that State. The cultivation of these plants has been but lately introduced into South Italy, Portugal and Spain. In the latter country, a feast occurs among the poor at the time of the ripening of the fruit in September. The fruit is in Spain considered so great a favourite that in the month of September hundreds of vendors sit in the streets of the town busily employed in stripping the fruit off the branches (which have been gathered loaded with it), their hands and arms being fearfully swollen with the spines that they have not leisure to avoid, so great is the impatience of the purchasers to obtain the fruit. In

Covent Garden market prickly pears are sold at the rate of two pence each. I may remark here that during the years 1870-71 and 1871-72, when the crops in some of the eastern talukas of the Poona and Ahmednuggur zillas were almost a total failure, the fruit of the prickly pear was generally eaten by Mahars, Mangs, and others of the poor class. In Greece the Opuntia vulgaris is used for hedges, and in Sardinia and Sicily for feeding pigs. O. vulgaris and O. cochinillifera are carefully planted and cultivated in Mexico, California, and on the coast of Grenada; also in the Canary Islands for fence material, and the latter species for the production of cochineal. The objections raised to using the Opuntia vulgaris as a hedge material and otherwise are, I believe—

Its unsightliness;
It harbours vermin;
Its tendency to spread;
It takes moisture from the land and adjoining crops.

With reference to its unsightliness, I acknowledge that we very commonly imagine we do not require it, and think that its growth at all is quite a mistake; but has not its unsightliness something to do with the fact that no general attempt has ever been made to make it really useful? It is permitted, unheeded and from want of common care, to earn a terribly bad name for itself. It covers the waste land adjoining many villages, grows there into large and lofty impenetrable clumps, affording shelter for vermin, and is unquestionably, thus situated, not only unsightly but a very great nuisance. In such cases it has mastered and not served us. The fault here, however, is scarcely that of the prickly pear, but rather of those that permitted it to attain unmanageable dimensions and to grow where it is not required. Grass grown upon neglected roads is unsightly, simply because it is "without the fitness of things," and is neither required nor useful there. I have seen very many well-kept prickly pear hedges, that had anything but an unsightly appearance, partly overgrown with creepers and with bushes and trees growing in their midst; the latter shielded from injury by the prickly pear from their youth up; on the contrary, they appeared, in the integrity of the expression, protecting hedges, strong, durable, and useful, and utility is certainly one of the lamps of beauty. "*It harbours vermin.*" When used as a hedge this is true, and as far as regards fields, plantations, and forest properties generally, it is probably an advantage, as if useful vermin are to be permitted to exist, they are less liable to do harm in the hedges than elsewhere. "*Its tendency to spread*" is apparently a far more serious charge. I acknowledge that if there is carelessness exhibited in the disposition of the cuttings of prickly pear; if, instead of being made use of, they are thrown about or allowed to float down a nala or river, they will, without doubt, take root where they are not required and become a nuisance; but a careful gardener does not throw his gathered weeds carelessly about; he collects them into a heap and burns them. There is not the slightest difficulty in drying and burning, as manure, pieces cut off prickly pear hedges that are trimmed during the hot months of the year, and this operation, moreover, at this season of the year, renders highly unlikely, if not impossible, the seeding of the plant, for it is only on large, overgrown, useless clumps, and on hedges left untrimmed from year to year, that the seed is procurable at all. This leads to the remark that, if the plant is everywhere made use of as a fence and nowhere permitted to grow to a massive, useless size, the seed will be difficult to obtain, and its undue spread about the land thus checked. In fact, by its general use, if what is here advanced is correct, the plant would require to be cultivated to obtain its seed; and this is the state of things from my point of view to be brought about. There are quantities of prickly pear hedges around house compounds in Poona that are exactly in the same useful orderly state they were fifteen years ago. They have given no trouble, nor is it found that the plant has spread itself into adjoining gardens or on the sides of the roads. There are some hedges, on the other hand, in a disorderly state; these, however, in most cases, are situated along roads and surround lands the property of Government. The prickly pear was used to protect from injury, by cattle and vermin, the many beautiful trees now lining the lately-constructed roads around Poona; but after its work was done with such a happy termination,—that is, after the trees were strong enough to take care of themselves,—it might have been cut down, burnt, and the ashes laid to the roots of the trees as a manure, and thus, as in life, so the plant would have proved useful when dead. Now, however, pieces are scattered about and some have taken root here and there, and by consequence, forgetting perhaps that it successfully fulfilled its mission as our servant, we stigmatise it as troublesomely persistent, and thus blame the plant for possessing a quality in which, from my point of view, its highest usefulness consists. *It takes moisture from the land and from adjoining crops*, is stated as an objection. Its power to draw moisture to the earth's surface, not only through hard and apparently hopelessly sterile land, but through disintegrated trap, is very extraordinary; but herein lies, I certainly think, one very strong argument in its favour, and I therefore, if upon no other account, strongly advocate its general use throughout those parts of the country where, by reason of a lack of moisture, or for other causes, it is difficult or impossible, without its assistance, successfully to grow other descriptions of living hedges. In the eastern districts of the Poona zilla, except in the Government babool plantations, scarcely a tree or a shrub is to be seen. Even those trees which formed the natural boundaries of fields and the limits of village lands are destroyed, and the land, during the hot months of the year lacking shade and the means of retaining moisture near the surface, becomes hard and cold, and unnaturally destitute of moisture. Should hereupon a scanty rainfall ensue, the land remains dry and unproductive. In most European countries much more attention than formerly is now being given to the construction

of living hedges and the growth of trees around cultivation In parts of Germany the Robinia pseudo acacia is, I believe, almost universally being grown around fields Prickly pear hedges will live and thrive and afford shelter, moisture, and preservation throughout the hottest months of the year, to plants and other living fence material, and without its help I doubt much if in the tree-denuded eastern districts of Poona living hedges of plants and trees will grow and thrive It is, I believe, argued that trees upon flat cultivated lands do not influence the climate This I cannot quite believe, but if such were the case, no one doubts that trees play their important part in supplying natural leaf manure for the soil and in bringing and retaining moisture near the surface by the law of capillary attraction A tree gives shade from above, and its leaves give off large quantities of moisture, but its roots, very far and wide-spread beneath the surface, have a still more important office to fulfil, large perhaps near the base of the tree, they end in the most beautiful minute hair like terminations which, by the natural law of capillary attraction, suck up moisture that would otherwise, by the law of gravitation, sink lower and lower, and far beyond the power of attraction which the roots of grain crops only can exert. Thus, where living hedges with shrubs and trees exist, there can be, even after the hot months are past and after, say, a very scanty rainfall, sufficient moisture retained near the surface to enable the earth during the cold months, when dew points can be reached, to distil its dew for the benefit of cultivation Let us suppose that when the value of living hedges and trees around cultivation becomes known to the natives of this country, and when the increasing value of land demands such permanent and valuable landmarks, and to avoid disputes, and again to obviate the necessity of the authorities of a village yearly, and after showers of rain whitening boundary stones with chunam, the people elect to grow living hedges around their fields then all the prickly pear which grows in the Poona zilla would not be sufficient for the purpose of forming the nucleus of the hedges in the Bhimthurry taluka alone After a few years, when the growth of the hedges and trees is secured through its instrumentality, the prickly pear can be cut out and used as manure or retained living to restricted dimensions Government have been asked to legislate upon the question, and to make the planting of prickly pear penal under an enactment, or in other words to prevent the use of that product of the earth which correctly used would be the means of covering such a tree-denuded district as Judapur with beautiful living hedges of plants and trees and thus, securing by their aid both moisture and valuable manure, turning, upon every occasion of a limited rainfall, an arid and unproductive district into a fertile one I cannot think of a more simple, inexpensive, and effective measure to arrest ordinary fires which threaten to enter a forest than to erect a strong prickly pear hedge around the forest By doing this you, moreover, permanently demarcate the forest limits Where grass grows to a great height, there two hedges will be required, say, about 30 feet apart The intermediate space must be thickly grown with scrub, bamboos, &c, to keep down, as far as possible, the growth of grass Very extensive tracts of denuded hill and mountain land throughout the presidency are now being made over to this Department for sowing and general conservation, prickly pear might with advantage be used to effect plant and tree reproduction upon some of these hills There cannot be a doubt that to obtain favourable results upon these denuded hill tracts, we must chiefly rely upon natural reproduction, and, with such large areas, confine our operations to thoroughly broadcasting them with large quantities of good healthy seed year after year and preventing trespass and grazing But while the more valuable of these mountains (and many of them from a financial point of view, are very valuable, as they yield a very large revenue from grazing) may with advantage be treated in this manner, those that scarcely yield any grass at all, with their reproductive powers at the very lowest ebb, must, I submit, have different treatment In commencing the work of sowing such denuded hills and mountains, the first consideration is, I think, to endeavour to make the hill land generate other produce than indifferent grass Having done this and provided shelter for plants, I submit that the growth of trees suited to the climate and soil is but a work of time I therefore would propose to fence with living hedges of prickly pear such reserved lands throughout, not only the boundaries of the reserve, but also, in lateral lines, contouring the hill say at intervals of 100 feet, these lateral hedges will bind the soil and prevent it from scouring down the sloping hill side, and will also afford the much-required shelter and moisture for young plants It will be necessary to set, in addition to lateral lines of hedges, also hedges from the base of the hill running upwards to protect the plants from strong winds and side light, thus giving the hill tract the appearance of being fenced into small fields of one or two acres in extent I think that, with the assistance of prickly pear, with its wonderful and abundant organs of absorption, any denuded hill or mountain, no matter what its state may be, can be made to grow plants and trees of one kind or other Now, if prickly pear is a valuable field manure, and I submit that it is, we shall, in using it as I suggest, not only obtain the result sought, *viz*, the growth of plants and trees on denuded hills, but also be supplying for general use a powerful and cheap vegetable manure There are three ways which have occurred to me in which prickly pear can be used as a manure *First*, burning it upon the soil for the production of humic acid, *secondly*, mashing it, thus realising all its abundant juices and mixing it with earth in the proportion of one of prickly pear to six of earth—this plan is suitable for planting road-side trees and blank places in plantations, and, *lastly*, by throwing it into ponds or tanks of water intended for irrigation, to decompose. In planting out blank places in plantations this year, prickly pear has been thus used with fair success by the district forest establishment I have this year personally used mashed prickly pear as manure for plants and young trees in my garden where the soil is very poor I find that mango plants with this manure remain free from the attacks of insects and

vermin. On the 20th June last I set six rose trees—transplants—three with this manure and three without it. The former three on the 10th August were covered with leaves, buds, and a few roses and were, and still are, entirely free from the attacks of insects. Two of the latter were entirely leafless, and the third was weak and upon one side leafless. The six rose trees were planted in a line about 3 feet apart. It was curious to note that the unmanured tree nearest the three manured trees threw out leaves upon the side nearest to the manured trees. There can be no doubt that the minute rootlets were attracted to, and the spongiets readily sucked in the gases generated by the prickly pear in a state of decomposition. The Superintendent of the Government Botanical Gardens at Gunnesh Khind, near Poona, wrote to me a short time ago concerning prickly pear as follows :—

"Since you drew my attention to prickly pear as manure, I have used several hundred cart-loads of it. I put it into a tank through which water for irrigation passes; of course, it decomposes rapidly, and the water carries away a large portion of the gases that are generated together with small pieces of half-decomposed vegetable tissue. What could be better plant food on a soil from which the vegetable matter has been collected and burned by so many generations? Thank you much for the idea."

In conclusion, and with reference to the medicinal uses of prickly pear, I can find only two or three curative properties that it is said in this country to possess, *viz.*, for bronchitis, especially in children, for whom, for this complaint, I understand, it is a specific. The fruits, deprived of their thorns, are placed in the fire for a few moments, are then squeezed, and the juice, mixed with a little sugarcandy, is drank. The other disease it sometimes cures is guineaworm. A leaf is deprived of its thorns and burnt in the fire, the outer covering is then removed, and the inner portion applied as a poultice. Though highly useful in certain cases of this complaint, it is far from being a specific for it. The fruit is both diaphoretic and diuretic, and has the property of staining red the urine of those who eat it.

Mr. Brandis thanked our colleague from Bombay for making us appreciate the Prickly Pear more than we had hitherto done. He then submitted two papers by *Mr. Ferrars* on Forest Administration in British Burma for the perusal of all interested in the subject. The following note by *Mr. Ferrars* accompanied his papers :—

The aim and object of forest administration in India is perhaps not only the ground which the various provinces have most in common, and which can accordingly be discussed to the greatest advantage at general conferences, but also one of the all-essential points to be defined. This consideration I endeavoured to introduce in the general conference of 1873. Another vital point, coupled with the above, and which I presumed to say should take precedence of matters of detail, is the acknowledgment of the fundamental principles to which the administration stands pledged. It may appear inexcusable to claim attention for a circumstance so patent; practically, however, while officers concur in the belief that satisfactory solutions of forest problems are impossible so long as the axioms and postulates from which we start are not even recorded, these, nevertheless, from year to year, remain a subject of mere tacit understanding, differing widely in individual cases. Although this Department be held responsible for the safety of the Indian forests, it possesses no Indian authoritative State acknowledgment of the broad principles of action on which scientific forest measures, from the greatest to the least, claim to have their merits tested. The unsatisfactory character of our reports, and it would follow in a corresponding measure of our work, may depend on the non-fulfilment of the two great primary conditions, the remedy for the first of which the Inspector General of Forests has chosen for his subject. The general principles which should guide the management of sâl forests are of course not those I refer to. To illustrate my meaning, I may instance the case of an officer peremptorily ordered to deliver some thousands of tons of a certain timber for a given purpose. As regards object of the administration, he has neither general nor special instructions as to how and whether the future productiveness of the forest in that particular timber is to be taken into account, nor, supposing that he had, can he appeal to any standard axiom, upon the ground of which the cost of operations should be raised, as the inevitable result of the recognition accorded to it. We have, I think, less occasion for studying the technical details of questions, such as that of the normal annual yield, than for obtaining assent to the proposition that the normal annual yield, when elaborated by the means of our science, is to be in practice the criterion of out-turn. So long as it is virtually—and, indeed, by many expressly—denied that there is any such science at all, it seems to me less to the purpose to pursue its development than to demonstrate its existence, and to obtain for it the beginning of a prestige which would lead to its subsequent universal application to practice.

Bamboo as a paper-making material.

The use of bamboo as a substance adapted for the manufacture of paper was then brought before the meeting. *Mr. Brandis* said that he understood in Lower Bengal it was the custom to cut all the stems of each clump and then cover the stumps with leaves and moist earth. Water is freely given and the result is a profusion of young shoots. Hitherto his observations had led him to think that too much thinning in a clump of bamboos resulted in an inferior crop of shoots, but it was probable that varying results might be obtained under different circumstances. His idea was that as paper could only be made from fresh

shoots, the carriage of this heavy material would be prohibitory, and therefore it would be necessary to make large plantations in the vicinity of the factory. He had, however, lately seen most interesting reports on the subject by Colonel Keatinge, Chief Commissioner of Assam, and by Mr. Gustav Mann, on the manner in which the extensive natural bamboo forests of Assam might be utilised for this purpose by establishing a floating factory on the river. *Mr. Brandis* was himself not very sanguine as to the success of using bamboo as a paper-making material in India, but there was no doubt that no better material for paper-making was known, and that if it was possible to overcome the difficulties and to utilise the vast quantities of bamboo produced in the forests of Burma and the north-eastern frontier districts it would be an immense advantage, and therefore he gladly seized this opportunity to recommend the study of this important subject to all foresters.

The following letters from *Mr. Routledge* to *Mr. Brandis* on the above subject were then read:—

From T. ROUTLEDGE, Esq., *to* DR. D. BRANDIS, *Inspector-General of Forests, Calcutta,—dated 3rd September* 1875.

I am obliged, and have to thank you for the attention you have given to my pamphlet and the subject generally of bamboos.

Until I return home to Sunderland, I am unable to refer to the letter I wrote you, but as I am unwilling to lose time, will make a few remarks on the subject of your memorandum.

A company established in Jamaica for working the bamboo on my process have some slight experience in planting, and I learn from my chemist, whom I sent out there some two months ago (by last mail, 5th August), that plant cuttings made 18 months ago have thrown up vigorous stems, two inches and more in diameter, although they have not been cared for properly, being smothered with bush. He also informs me that root off-sets produce much more quickly, giving vigorous stems the first year.

This, to my thinking, accords with what one might expect, judging from analogous growth in this country, division of the roots by eyes, rhizomes, runners, shoots, &c., &c., producing stools the ensuing year with stems or leaves or heads, such stools increasing largely and being again ready for division after producing their season crop; rhubarb, asparagus, scakale, raspberries, strawberries, filberts, horseradish, the iris, all the liliaceous plants and a host of others being familiar examples.

I consider that looking at the bulky nature, and I may add weight also, of the young bamboo stems, that the costly item of carriage must be economised by making plantations near the factory (as quoted by you in your memorandum); and I see no reason why the bamboo should not be cultivated in the same manner as sugarcane now is, by plant cuttings or root off-sets, the shoots of which should be allowed to rattoon (as sugarcane) so long as the nature of the soil and climate of any given locality will permit the shoots so formed to maintain vigorous and productive growth.

It appears to me that dense growth of stools,—that is, stools already existing, *old*, and possessing or producing a large number of stems, even if such stems were cut down in their entirety, or merely thinned out,—would not reproduce any quantity of young stems, inasmuch as the interior of the said large stool must be crowded with root-growth, and no room or space for young eyes or rhizomes to start. I fancy the most active growth or extension of root stools is from their exterior diameter—off-sets from round the circumference; at least I have found it so almost invariably with all my experiments, especially with orchids, plantains, bulbous plants, &c., and plant-slips with roots or rootlets attached. The growth of Esparto (*Lygeum Spartum*), or Alfa (*Stipa tenacissima*) is very similar, huge tufts or stools (called "Atochas" in Spain) being found, the plant attaining considerable size, but spreading from and on the outside, with roots bulbous or semi-bulbous attachments, somewhat like the shallot, or garlic, getting stronger from year to year.

To look for a supply of stems from a distance, to be cut and collected by natives from existing stools (as you say from native village groves), would, I consider, be quite out of the question, as one would have to be dependent upon the judgment, or rather on the greed, of the native collectors, who naturally would cut those stems which were attainable with the least amount of trouble, and thus delivery would be made of old and young stems mixed together indiscriminately, involving great difficulty in separating one from the other, and when so separated, the old stems are only valuable for firewood.

Now, by forming regular plantations, and cutting at stated intervals, or as the stems were in the proper condition, the succeeding growth and subsequent cutting could be very readily supervised and controlled, and properly organised and arranged; fresh plantings or root-stools might be formed to keep up regular succession.

I may remark that on the property I have referred to in Jamaica, the bamboos flourish *most* in a moist soil, in fact best near a river which traverses the estate; the variety so far as I can judge appears to be *bambusa vulgaris*. Judging also from a small parcel of stems I have just received from Demerara, this variety appears to be *bambusa vulgaris*. Last week at our

works I treated some 10 cwt. of these stems which came to me in their entire length (not crushed), and ranged from 10 to 20 feet long, all diameters from 1½ inches to 4 inches. Rejecting the extreme hard ends, I passed the whole through the mill and made the paper enclosed, which is of excellent quality, thus incontestably proving my assertion of the value of "bamboo as a paper-making material." I am having a reprint of my pamphlet made on this paper now in the press, and I will send you a copy next mail.

I have come to the conclusion that any attempt to grow old and young stems on the same stool at the same time will fail, inasmuch as the main root and sap action would go to mature the old stems, and thus nullify, or at least diminish *pro tanto*, the production of young stems. The Chinese system, I am informed, is to create stools from plant cuttings, which, kept free from weeds and brush, will produce fair-sized stems in three years, when they are all cut, but *not* at the butts, on the contrary, higher up, leaving several feet or internodal joints standing; fresh shoots then spring up, especially in congenial moist soil or if irrigated: these in their turn being cut in like manner, when the older stumps may be cut down short and are available for fuel. This system has been also, I learn, lately practised in the West Indies, with the addition of planting root off-sets which furnish stronger stems at an earlier period of development, that is within two years instead of three years.

I can understand that by the present system of cultivation, that is, large clumps occupying a large amount of space, an acre of land would only produce 40 clumps (as you say in your memorandum), and also, if the old stems were left standing and growing, thus assimilating the major portion of the root-action, and at the same time developing woody fibre by the leaf-action, causing the return sap to deposit lignine and silica, that only 8 shoots or thereabouts would be produced from each stool. But, assuming that the system of cultivation I have indicated was followed, similar to that for sugarcane, cutting the stems when sufficiently grown for my purpose, stimulating fresh growth by irrigation, or if need be by manure, the resulting crop of stems annually to each acre would be very very different. For sugarcane, hemp, flax, rhea, and a variety of other plants cultivated, manure is freely given; then why not for bamboo, a more valuable crop than any of them?

You ask "whether I have experimented on rice straw." I send by this same post a copy of my pamphlet printed on paper I have made from rice straw, and the cover,* enclosing the pamphlet, is made from the same material; under same cover you will also find another pamphlet printed on paper I made from maize leaves (Indian corn). The *Holcus saccharatus* also will make good paper, so will millet, and I have made excellent paper from megasse, sugarcane refuse. In fact, as I state in my pamphlet, the paper-maker can make paper from any vegetable fibre or fibrous tissue; it is merely a question of degree, that is to say, the quality of the fibre and its cost delivered to him. I do not think the quality of stock producible from paddy or rice straw is sufficiently good to allow of its being manufactured and sent to this country from India to pay, although it would pay to convert it into paper there in India, making a medium quality of printing paper, in fact such as you will remark in the pamphlet. Rice straw, also maize straw, both contain a very large quantity of gluten; this latter from maize leaves, when treating them to reduce the fibre for paper, I have collected and made into wholesome bread and biscuits. The yield of fibre is, however, not much more than 30 per cent, whereas bamboo gives a yield of 60 per cent., and megasse of 40 per cent.

I have made a good quality of fibrous stock from *Broussonetia papyrifera*, as also from the bark of the ordinary mulberry cultivated in Italy and France, for sericulture, and a very beautiful material it is, or would be, if procurable in large quantities, and cheap, but the preparation like rhea would be costly, as the stems would have to be retted, the bark stripped, and the outer bark separated, and then submitted to boiling, &c., &c.; whereas bamboo requires none of this, and is, or should be, procurable under a proper system of cultivation in very large quantities—an essential point in introducing any new material, as small parcels will not be looked at. A paper manufacturer will not buy any fibre new or old, good, bad, or indifferent, unless satisfied that the supply in the market will be reliable and continuous. I have also made good paper from the *Musa textilis*, Manilla hemp, and the stems cut down after fruiting both of plantains and bananas would yield a fair fibre for paper-making, but it is somewhat questionable in my mind whether it would pay to cultivate them for that purpose—I mean in view of a material so very much superior, and so very much cheaper in bamboo, or even megasse, the yield of fibre to the bulky stem to be treated being so inconsiderable.

From the wording of one portion of your memorandum, it might be considered that the use of the stems in their fresh state was an essential. This is not precisely so, although it would be desirable and almost necessary to crush them when fresh and green; thus crushed, dried, and kept dried under cover, so as to preclude fermentation, they will keep a long time. I have stems by me now upwards of 14 months old—always, however, whenever possible, I prefer using the young stems as and when cut.

And now, dear sir, I must bring this somewhat lengthy letter to a close, begging you to reconsider the question, as you will, I trust, excuse my saying, your remarks somewhat throw cold water on my scheme, so far as the production and cultivation of the bamboo is concerned; and I imagine it will be the desire of the Government, as in the case of rhea, cotton, tea, coffee, cinchona, &c., &c., to encourage rather than discourage a new cultivation, which I venture to believe will prove very important in the future.

* The cover of the pamphlet itself is made from jute, and excellent it is.

From T ROUTLEDGE, Esq, *to* DR D BRANDIS, *Inspector-General of Forests,—dated* 11*th September* 1875.

I have the pleasure to forward you, per this mail, copy of my pamphlet printed on "bamboo," or rather on paper made from the bamboo at these works, and for a first trial, I think you will agree with me, the quality is very good I can only say as a paper manufacturer, that I wish I had this material to deal with in lieu of Esparto both for quality and cost.

I must, however, in the face of your letter and memorandum sent me, somewhat qualify this latter remark as regards cost, as if we are unable to obtain a better produce to the acre than you estimate, bamboo would certainly be too dear. I cannot help feeling, however, that if a systematic method of cultivation by root off-sets or stem cuttings were adopted on a similar plan to that practised with sugarcane, that a similar cropping would result, but in this event no old stems must be left growing, and, if need be, new plantations formed as required, leaving the old stools to grow and form fuel

I doubt not, however, this important matter will receive due attention from you, and that you will organise some practical method of testing this as speedily as possible, as the necessity for some fresh supply of material for paper-making is becoming more urgent every day Spanish Esparto, and that of very indifferent quality, is now selling at £13 per ton, and the Algerian grass coming forward this season, owing to the snow and heavy rains last season, is also of poor quality I will not abuse your time by repeating my former letters, but await further news from you I should like to know your opinion of the paper (bamboo) sent

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**From* T ROUTLEDGE, Esq, *to* DR D BRANDIS, *Inspector-General of Forests,—dated* 29*th September* 1875.

I have to acknowledge and thank you for your letter of 21st August, covering memorandum extract from Mr Ribbentrop's letter I have written to him and fully explained that, broadly speaking, I see no reason to doubt that, like other fibre-producing plants, any species of bamboo would be available for paper stock I assume as a matter of course that the fibrous tissue in the stems of the larger varieties of bamboo would be, probably, coarser and stronger than from the smaller varieties, and also would vary according to climate, soil, and local circumstances

I assume that the more rapidly the stems can be cut, or made to grow, the better,—that is to say, that as in the analogous growth of edible vegetables, the more rapid the growth, the more succulent and tender the stems. I also infer that as the bamboo stems contain so large a quantity of sap or moisture, plenty of moisture must be supplied to their roots for their sustenance, rapid assimilation demanding rapid supply For example, I sent a gentleman some three months ago to Algeria to inspect some Esparto districts for me, and desired him to visit the Jardin d'acclimatation at Algiers, where I knew they had an avenue of bamboos growing, he found the young stems growing, but dying for want of water, they having had an extraordinary scarcity of water We know a similar result would affect the sugarcane, failure of crop being no unusual occurrence in the West India Islands from a droughty season.

In Demerara this seldom or never occurs, as they have from 90 to 100 inches of rain spread over the year, and their lands, moreover, require constant drainage—a great source of expense to them, but then they crop the sugarcane 300 days out of the 365, and good crops too I am informed by friends there that the bamboo grows freely and abundantly from stem cuttings all the year round, and the more it is cut the better it grows, they plant it for fuel, and I am assured by planters that they assess the value at a dollar (4*s* 2*d*) per ton, cut and delivered to the mill.

I feel pretty certain that growing old stems on the old stools will simply nullify any economical production of young stems from such stools, as naturally the old growing stems will absorb all or the main root-action Young stools must be formed, cut some 4 to 5 feet from the ground My man writes me from Jamaica that he finds those stools that have been most cut are in the best condition, and, on the contrary, the old stools not cut are in poor condition. Friends of mine are about starting my process in Jamaica, and his report is made on bamboos growing on that property, some 3,000 or 4,000 acres, with a navigable river running through it, the bamboo being most luxuriant on the banks of the river, and on an adjoining property where they grow and cut the bamboo for fuel, returning (as they should do) the megasse to the cane fields for manure, the bamboo grows best near the water, that is *running* water, as in an adjacent morass there are no bamboos

You will, I hope, excuse the prolixity of my remarks, but from the tenor of your memorandum I am very much afraid that attention will be confined to old existing stools; and, if so, I fear nothing but failure will or can result, whereas, by forming young stools from plant or stem cuttings and root off-sets planted in rows on properly prepared soil (that is freely opened up) and well drained, a heavy growth of young stems would be ensured per acre You remark in your memorandum, "whenever you have seen clumps over-cut, the result was a scanty crop of young shoots, they being thin and short" This I can understand coarse grass turfs taken from a meadow, put on a hard bottom to form a lawn, cut or rather mown short frequently, will rapidly form a fine soft growth, take, however, meadows cultivated under irrigation or rye grass under sewage, coarsely mown for stall feeding, and the reverse is the case

* This letter was received after the close of the Conference, but it is printed here as it contains interesting suggestions

I imagine that the stems you refer to will have been cut closely down to the stools, but the Chinese allow some feet of stump to stand, and this also is the practice on the estates I have referred to in Jamaica, as they found that cutting down too closely ruined the stools. I find in my hot-house that root off-sets grow freely, tearing the rootlets apart does no injury and produces no check, fresh shoots having been formed.

I think I mentioned in a former letter having planted *B. stricta* (sown in February) in a drain tile. I have since added two other larger drain pipes to the bottom of the first one, and the roots have reached the bottom strong and vigorous, as is the plant; the roots as thick as a goose quill grew 10 inches in 7 days, and if my house was warmer and supplied with more bottom heat, absorbing and assimilating more moisture, I feel satisfied I should have had far more rapid growth. I have also cut down several plants, not close, but some distance above the surface of the stool or pot; I saw no check, but fresh and stronger stems have grown up.

Having satisfactorily solved the question of the adaptability of the production economically and simply of good paper stock from bamboo, and also made good paper therefrom, I am naturally most anxious to resolve the no less important questions of the propagation, cultivation, and growth of bamboo, as one without the other would be the "play of Hamlet with the part of Hamlet left out." I am very grateful for the attention you have already given to the subject, the importance of which can hardly be over-estimated, not only to India and other British possessions where bamboo can be economically produced, but to a very large staple trade in this country. We have now Esparto at famine price, £13 per ton, and when trade revives, and demand for paper necessarily increases, I really don't know what paper manufacturers can do. *Broussonetia papyrifera* is a beautiful material for paper without doubt (I have made excellent fibrous stock from stems of the Italian and French mulberry, raised for silk-worms); but assuming that the Broussonetia can be grown in India as in Japan (which I do not doubt), its cultivation, cutting, and collection would cost more than the bamboo, and its preparation to fit it for paper stock would involve considerable labour and expense, as it would have to be treated like all exogenous fibrous plants, the stems dried, steeped or retted, broken, and the corticular fibre separated from the woody interior; and what then would be the produce per acre?

Under the most favourable circumstances, jute will not give more than 9 to 10 cwt. per acre; rhea with 4 crops, Dr. Watson estimates, may give 7 to 8 cwt. of fibre per acre; and we know the average yield of flax to be 4 to 5 cwt., hemp 6 cwt.; and I do not think the Broussonetia would yield more. If bamboo can be brought under profitable cultivation as other vegetable fibrous and non-fibrous plants have been, either by irrigation or manure, or both, I see no reason to doubt that it will afford a far greater yield of available fibre than any other plant, not even excepting sugarcane.

I send you a pamphlet printed on paper made with a large blend of *Adansonia digitata* with Esparto; it is a splendid material, but it would appear that the Baobab tree is rather difficult to get at, as I am unable to procure any. This fibre very much resembles, especially in the innermost layers, the mulberry tribe. I have made beautiful stock out of the lace bark from Jamaica and Demerara, but the main question is facility of supply in large quantities at reasonable prices, as unless, in introducing either a new material semi-prepared or a new material in a raw condition, the manufacturer can feel somewhat assured that he can rely on a continuous supply, and at a price not liable to violent fluctuations, he will hold aloof.

An old adage, and I will close this long letter—"While the grass grows the steed starves;"—any experiment or experiments in planting should be on a practical scale, seeing that under favourable circumstances such a plantation would take two or three years to become productive.

Mr. Amery remarked that Mr. Routledge had not sufficiently taken into consideration the cost of carriage to the seaboard, and in supplying bamboos from the North-Western Provinces, certainly the cost of carriage would absorb the profits mentioned in Mr. Routledge's letters.

Mr. Brandis stated in reply that in his opinion the forests of the North-Western Provinces could not spare any bamboos at present for this purpose, for the entire produce was urgently needed for building and other purposes in the plains.

Forestry in Japan.

The following communications, with reference to Forestry in Japan, were then read to the Meeting:—

From Major Walter Howard, *to* Colonel Dillon, *dated 13th August* 1875.

When in Japan, I had the good fortune to meet many Japanese of good position both socially and officially (amongst others General Siego, the successful Formosan General); and I was asked by the Vice-Minister of Public Works if I could obtain for his chief, through any friend in India, certain information from the Indian Woods and Forest Department. I promised to do my best, and thought that you might befriend me in the matter. The first thing he wants to know is, whether there is any tree in India of tolerably quick growth that would supply in a few years charcoal for smelting purposes. The tree must furnish a hard charcoal, and not a soft one, such as would be required for gunpowder. The second question refers to teak what soil does it grow in, and would it, probably, thrive in Japan? If it would, how is it to be propagated, and how are seeds and cuttings to be obtained?

Mr Yamao Yaro, the Vice-Minister of Public Works, is exceedingly hot upon the subject, especially the first, as they have been making too free with the timber for steel manufacture, and Mr Yamao Yaro is desirous of taking thought for the future He offers in exchange any information relative to Japanese trees, and would take any trouble in getting seeds, &c If you know any one in the Department desirous of information, &c, on such subjects from Japan, if they would write to the Vice-Minister, I am sure he would be much obliged, and would put himself out of the way to obtain anything they wished

The following memorandum by Mr. Brandis, sent in reply to the above letter, was then read —

"1 A tree of tolerably quick growth that would supply in a few years charcoal for smelting purposes

"What is required is a hard wood that coppices freely, such as the ash or sweet chestnut of Europe Several of the tropical Indian woods would answer admirably, but they would not thrive in the temperate climate of Japan I would suggest that the species of Eucalyptus which are found in temperate Australia and Tasmania, such as *Eucalyptus globulus* and *obliqua*, be tried, as well as two species of Acacia also from temperate Australia and Tasmania, *viz*, —*A adealbata* (the silver wattle) and *A Melanoxylon* (the Australian blackwood)

"But I should be inclined to expect more success from some of the indigenous Japanese trees, many of which I understand are grown as coppice woods The oak, which is cultivated to feed the Yamamái silkworm (*Quercus serrata*), might prove useful If I am correctly informed, there is no country where the management of coppice woods is so well understood as in Japan

"2 Teak in Japan is hopeless, I think, Indian Teak is not found north of the 25th degree North Latitude, and it thrives best within the tropics In gardens, it is cultivated in Northern India, but as a forest tree Japan would be out of its range altogether"

This brought the proceedings to a close, and after a vote of thanks to the Chairman, the Conference terminated.

APPENDIX I.

THE following papers were contributed to the Conference, but were not read for want of sufficient time.

The influence which Forests exercise on the climate of countries, by M. J. CLAVÉ, *being a resume of an article in the Revue des deux Mondes, 1st June* 1875, *by Lieutenant-Colonel Pearson.*

It is proposed in the following paper to consider the influence which forests may exercise on the climate of a country, and especially on its rainfall; but before proceeding any further, it will be best, in order to clear the ground for the better understanding of the subject, to give a short explanation of the laws (so far as they are known) which govern the great movements of the atmosphere surrounding our globe. This atmosphere extends generally to the height of about 40 miles above the earth's surface, but this height is neither everywhere nor always the same. It may be compared to a sponge filled with water which, when it is subjected to any compression, voids a portion of that water in the form of rain, its dilation being followed by the contrary effect, that is, by the absorption of more moisture.

In the higher regions of the atmosphere the air is exceedingly rarified and the temperature very low; but the temperature and density of the air both increase simultaneously in proportion as the earth's surface is approached. The weight of the atmosphere is measured by the barometer, the height of the mercury in the tube indicating the height of the atmosphere above us at the time being; and since in any fluid body the particles or atoms at once commence to force their way from the points where they are in excess to those where they are wanting, when the barometer is low, that is, when the height of the atmosphere above us is below the mean, currents of air or winds are produced, in order that an equilibrium may be restored.

The air always contains a certain quantity of watery vapour, and this is greater in proportion as the temperature of the air is higher. If the atmosphere becomes cooled, a portion of that vapour is condensed, and falls to the earth in the form of rain.

The sun's rays in the neighbourhood of the equator warm the masses of gaseous vapour in contact with the earth; when warmed, these become dilated, and imbibing moisture from the sea by the process of evaporation in the same way as a sponge sucks up water, rise to the higher regions of the atmosphere. There these great bodies of heated air and water form a gigantic belt called "a cloud ring" round the earth in the neighbourhood of the equator; and as they become massed and pressed together, they glide away towards the north and south, down the convex sides of each atmospheric hemisphere, while the cold air from the poles rushes back to occupy their place, in the same way as the difference between the temperature of a heated room and the outside air produces a draught in the chimney of a house. Thus a double current of air is produced in each hemisphere,—namely, one from the equator to the poles in the higher regions of the atmosphere, and the other from the poles to the equator in the lower regions. Were the earth stationary, these currents or winds would blow always directly north and south; but since the earth rotates on its axis from west to east, and since its motion is more rapid at the equator than near the poles; in the northern hemisphere, each particle of air, in advancing northwards, becomes deflected more and more towards the east, so that the current of air, which blows from the equator to the poles, becomes successively, first, a south-west, and then a west wind. But the body of air which is travelling continually northwards finds, the farther it goes, a narrower space to occupy, owing to the gradual narrowing of the parallels of longitude as the north pole is approached; and the consequence is that it is driven back on itself, and so becomes, as it were, broken up, escaping in various directions, and forming irregular currents or winds. At the same time the return current from the pole to the equator meets parallels of longitude where the rapidity of the earth's rotation increases in proportion as the equator is approached; thus it becomes deflected more and more to the west, and tends to become an east wind; and as the space which it has to occupy enlarges itself, the current itself becomes in consequence more feeble and regular. So we find near the equator trade winds and monsoons which blow for months together in the same direction, while in the higher latitudes we find a more irregular atmospheric action in proportion as we approach the poles.

Again, according as these currents or winds traverse continents or oceans, they imbibe either heat or moisture in greater proportion and become dry or moist winds, bringing with them either fine weather or rain,—so of the mass of vapour which is drawn by the sun's rays from the ocean in the neighbourhood of the equator, a portion falls immediately in the form of rain, consequent on its condensation by cold in the higher regions of the atmosphere; and the rest is driven, as shown above, towards the temperate regions of Europe, where it turns into rain and falls to the earth as often as the lowering of the temperature or other local circumstances produce condensation. The return current from the pole, having thus got rid of nearly all its moisture, in its passage across the earth's surface, becomes a hot or dry wind, and thus is fitted once more to absorb moisture, which it does in the neighbourhood of the equator; and so it comes to pass that the great meteorological actions of the atmosphere are continually repeating themselves.

In our hemisphere there exist two great main equatorial currents, one of which has its origin in the Pacific, the other in the Atlantic Ocean.

The latter of these follows very nearly the course of "the Gulf stream" in the sea, being deflected to the east as it proceeds northwards, and becomes a west wind by the time it reaches Sweden and the Gulf of Finland.

Arrived in these regions, and its temperature having been sensibly cooled, it becomes changed into a polar current, and after traversing Eastern Europe and a portion of Asia, returns to the equator as a north-east wind.

Such, then, is the general direction of the great aerial currents; their regular course, however, is affected within certain limits by causes which are as yet but very imperfectly understood. Among these disturbing causes are cyclones or circular storms which seem to be eddies or whirlpools which the great atmospheric currents create along their ever-moving sides; of their exact nature no doubt now exists, as they have been proved to be currents of air or storms revolving with great rapidity around centres of barometric depression, which themselves remain calm. These centres have at the same time a progressive motion, and, as their rotatory direction is always the same way* in either hemisphere, the direction that their centre bears from any given point can easily be ascertained through the successive shiftings of the winds and their main danger thus avoided by a careful observer. It would seem that, as a general rule, cyclones are formed near the equator and in this hemisphere travel northwards, following the coast of America till they reach Europe, which they cross sometimes as far north even as Iceland and finally wear themselves out in the extreme eastern parts of Asia, where in the China seas they are especially dangerous. Of late years arrangements have been made to telegraph their approach across Europe which must have tended to save thousands of human lives.

Without going further into the subject of meteorology or following out the speculations which some have entertained on the influence of the moon on the changes of the weather, it may be accepted as a general law that the heat of the sun causes the absorption of vapour by evaporation, while the lowering of the temperature causes the rain to descend through the action of condensation. We will now endeavour to trace how far forests have any influence in bringing about and regulating these actions.

II.

The influence of forests in affecting the climate of countries has been exceedingly contested; denied by some, it is admitted by others, who are, however, by no means agreed as to the manner in which that influence is exercised.

The fact is, that the phenomena through which it is manifested are exceedingly complex and often disguise each other, so that, to understand their effects at all clearly, a careful examination of each action of these phenomena is necessary.

There are four separate actions of nature through which it may be said that forests influence in some way or other the physical condition or climate of a country: *first*, there is a chemical action through the leaves in decomposing the carbonic acid of the air; *second*, a physical action in retaining moisture in the earth and in checking the violence of the wind; *third*, a physiological action in transmitting to the air, through the leaves, a portion of the moisture which the roots draw from the earth; and *fourth*, a mechanical action, through the roots, in retaining in its place the earth, especially on the sides of mountains and hills. Let us examine briefly each of these.

It is well known, as regards the first, that the carbonic acid of the air is decomposed through the action of the leaves of trees causing an assimilation of carbon in the woody tissues of their trunks and the throwing-off of oxygen into the atmosphere. It is argued that this must cause a lowering of the temperature, inasmuch as the wood, to give out heat when it is burned, must necessarily absorb it while it grows; so that forests are, in fact, great condensers for extricating and storing up caloric, to be given out again at a future time of need.

Facts seem to confirm this theory, and several works have been written to prove its truth. MM. Becquerel and Bossingault instituted a series of observations which they published,† proving that the temperature of forest-covered countries is from 6° to 7° Fahrenheit (2° Reaumur) lower than that of countries which are denuded of wood. The observations of M. Mathieu of the Forest School at Nancy and of M. Fautrat are more recent and more exact.

M. Mathieu established three stations, each with a complete set of instruments, for measuring the rainfall, temperature and moisture of the atmosphere in the neighbourhood of Nancy so far back as 1866, since which date observations on these points have been noted down and collated by him,—observations which, extending as they do over a period of nearly ten years, are exceedingly valuable. One of the stations selected by M. Mathieu is in the middle of the forest of Haye, about five miles from Nancy; a second is just on the border of the forest at "la Belle Fontaine," and at about the same distance from Nancy; and the third is at Amance, in an open, but moderately-wooded, though purely agricultural, district, 10 miles from Nancy. The results which M. Mathieu has obtained are singularly uniform, and they have been reproduced so often that even so careful and conscientious an

* It is ascertained that cyclones rotate with the hands of a watch in the southern hemisphere, and in a contrary direction in the northern.

† Des Climats et de l'Influence qu'exercent les Sols Boisés et Non Boisés, par M. Becquerel, 1853.

observer as M. Mathieu considers that they may be held to be dependent on a general law of nature. They may be summed up as follows:—

1*st*—That the mean temperature in a forest is *always* lower than in an open, unwooded tract of country.

2*nd*—That this difference is less sensible in winter than in summer.

3*rd*—That in a forest the maximum temperature of day and night, taken together, is always lower, and the minimum temperature always higher, than in the open.

4*th*—That in a forest the changes from heat to cold, and *vice versâ*, operate more slowly.

5*th*—That the day and night temperature is more nearly alike, also that the change of temperature from one day to another, and from one season to another, operates less rapidly in a forest than in the open.

6*th*—That sudden changes of temperature, when they do come, being more gradual, are less felt in the forest than in the open.

And in regard to details:—

1*st*—That throughout the year 6 per cent. more rain falls in the forest than in the open;

2*nd*—That, of the rain which falls throughout the twelve months of the year, about 10 per cent. is caught by the leaves in a forest and does not reach the earth.

3*rd*—That the evaporation in the open country is five times as great as in a forest, in consequence of which the soil in a forest notwithstanding the diminished amount of rain which reaches the earth, retains its freshness and moisture long after that in the open has become thoroughly dried up.

M. Mathieu's observations then lead to the conclusion that, while, on the one hand, forests tend to lower the general temperature of a country and so to promote the fall of rain at regular intervals and in moderate quantities, on the other hand, they ward off sudden meteorological changes, which are dangerous, inasmuch as they cause sudden and heavy falls of rain, which result in floods and other like disasters.

The observations of M. Fautrat, though extending over a much shorter period of time, have a greater value than even those of M. Mathieu, in regard to the direct action of forests in regulating the temperature through the decomposition and assimilation of carbon and the emission of oxygen in the air. Apprehending that objections might be raised as to the value of M. Mathieu's observations, on the ground of the distance of his stations from each other, as well as of one of them from the forest, M. Fautrat, whose observations were made at Fleurines, in the forest of Halatte, erected his instruments almost close together: one pluviometer was placed 25 feet above the tops of the trees inside the forest, and the other in the open plain, but close to the border of the forest, 250 yards only from the first, and at the same height from the ground. During the eight months over which the observations extended 11·80 inches of rain were measured in the pluviometer inside the forest, while only 10·95 inches were measured in the other, which was outside, being an excess in favour of the former of 8 per cent., while the amount of moisture in the air above the forest, as compared to that above the plain, was as 63 to 61.

Furthermore, of the 11·80 inches of rain which were registered in the forest pluviometer, only 7·07, or about 60 per cent., reached the ground; while at the same time the evaporation was five times as great outside the forest as inside it. These results, being obtained at stations situated so near each other, are exceedingly striking, as they tend to prove a considerable direct influence in forests on the amount of rainfall and moisture.

It will be observed that M. Fautrat's observations give an excess of 2 per cent. over those of M. Mathieu in the amount of *excess* rainfall in forests. It is probable that this is owing to the fact that M. Mathieu's observations extend over the whole year, including the months during which the trees are denuded of leaves, when the particular influence now under discussion is necessarily not exercised at all, while M. Fautrat's observations were taken for a period of eight months only, during the greater part of which the trees were in leaf. The difference between the amount of rain caught by the trees, as shewn by M. Mathieu and Fautrat, must be thus accounted for, as, by including the winter months, the average is of course considerably lowered.

M. Cautegril, Inspector of Forests at Carcassonne, near Toulouse, in the extreme south of France, also carried out a series of similar observations with pluviometers scattered at different stations over his department (Aude), and with precisely similar results.

Again, it is certain that several descriptions of trees, notably pines and firs, as well as the Australian eucalypti, and the Indian neem, are powerful agents in deodorizing and purifying the air by the chemical action of their leaves, and thus checking malaria. In this way many cities which were previously extremely unhealthy have been rendered not only habitable but salubrious by the planting of trees. Indeed, wherever forests have a prejudicial effect on the health of places, it will generally be found to be caused by the rank undergrowth, and not by the trees.

Let us pass on now to the physical action of forests on the air. This may be said to be two-fold: 1*st*, by preventing the loss of moisture through evaporation and so promoting its absorption by the earth; and 2*nd*, by acting as a barrier to the violence of storms. It has been shewn above that so great is the protection afforded to the earth in a forest by the leafy canopy which covers it, as well as by the bed of dead leaves on its surface, that only one-fifth of the moisture is lost by evaporation, as compared with the loss by the same action in an unwooded plain, and that this is the case, although a considerably smaller portion of the rain which falls actually reaches the earth. The bed of dead leaves in the forest acts like a sponge, soaking up and retaining the rain and regulating its distribution, or through the roots of the trees,

which act like vertical drains, promoting its descent into the lower strata of the earth, there to nourish the springs. More specially in the mountains is the benefit of forests, when they act thus, felt; as the melting of the snow often sets at liberty within a very short time a large amount of water, which, if not so caught and absorbed, would run off unprofitably, and often would cause terrible and destructive inundations.

For proofs of the former it is only necessary to turn to countries which are denuded of trees, as is the case with Central Asia and Upper India. The vivid description of a dust storm in the desert by the great traveller Vambery is hardly needed by those who have seen a dust storm in the North-West of India, to enable them to realise the power of the wind in a country where its violence is unbroken by the presence of trees, and it is well known that violent hail storms are never known in well-wooded countries. Indeed, hail is formed by the intense cold produced by rapid evaporation, which absorbs the latent heat contained in the drops of rain as they fall rapidly through the strata of over-heated air. As has been shewn above, in a forest, on account of the greater degree of moisture in the air, evaporation goes on much more slowly than in the open, and consequently the conditions necessary for forming hail are not present.*

But, thirdly, forests have a physiological effect on the atmosphere, inasmuch as they withdraw from the soil a certain amount of moisture, a portion of which only is assimilated in the woody tissues of the trees, while the rest is thrown off into the air by the transpiration of the leaves. This action probably acts as a natural balance to the greater amount of moisture which the presence of a forest retains in the soil. Instances without number may be adduced of this action on a large scale, notably in the Dunes of Gascony south of Bordeaux,—at Sologne,—and at St. Amand (Nord),-where plantations of firs on a large scale have had the effect of draining the marshy lands in their vicinity. But the phenomena connected with this portion of the subject have been insufficiently studied, and there is but little really known as to the difference between the action of forests through evaporation and that of ordinary field cultivation, nor even as how far the effects produced, as cited above, may be due to the direct action of the roots as drains, and not as absorbents. It is hoped that further enquiry will be directed to these points.

Lastly, a few words must be said as to the mechanical effect of the roots of trees in retaining the soil in position, especially on the sides of mountains and valleys,—and so in preventing their denudation. This effect of forests, being self-evident, has been, unlike the first three, but little disputed.

The works of the French Forest Department, in the Hautes and Basses Alpes, are now generally cordially acknowledged even by their former most sturdy opponents—the sheep farmers and municipal councils of those Departments—where the grazing interests are so strong that, to increase the area of grazing ground, the forests had been gradually almost destroyed. So great indeed were the devastations from which these Alpine districts sufferod through the denudation of the mountain sides and the consequent formation of torrents, that intervention of the most prompt description became necessary to prevent the destruction not only of the grazing grounds themselves, but of the rich valleys below them. The Government has now at a vast cost undertaken the replanting and regrassing of these mountains on a most extended scale, and many thousand acres are, every year, being placed out of danger by the works undertaken. Already the beneficial effect of what has been done is felt in the diminution of the violence of the torrents, and, as the trees grow up, the benefit will be far more widely felt. It may be observed that during the present summer, where so much mischief has been done in the south of France by inundations, the Durance, which rises in the mountains east of Avignon and which on former occasions has been the worst and most dangerous of all the rivers in the south of France, on account of the inundations it has caused, has scarcely been heard of, and it is around the head waters of this river that the chief plantation works have during the last ten years been carried on; a better proof could not be adduced of the value of these operations.

III.

From what has been said above it will be seen that the action and influence of forests on the climate and physical condition of countries is yet but imperfectly understood; nevertheless, it seems clear that such an influence exists, though it varies in different countries, according to their different physical conditions, being more marked in hot climates than in cold ones.

It is certain that forests tend to lower the temperature. There is evidence of this in the fact that in the time of Cæsar, when the greater part of France was covered with forest, large rivers like the Rhone, were commonly frozen over in the winter, so that, as the great commentator relates, they bore his armies, which were able to cross them. It may be also allowed that in countries denuded of wood the rain falls, if not in less quantity, yet more seldom and with greater violence, and so does less good than in wooded countries. The reason of this probably is that in an open country the sun rapidly heats the air, which absorbs the watery vapours without condensing them, and does not void them again in the form of rain, except on the pressure of contrary currents, or on some such atmospheric disturbance, while in a wooded regions the temperature is naturally lower, so that the vapour, being condensed as it is absorbed, falls regularly in the form of rain, without waiting for some disturbance of the air to cause it to descend. It is evident also that both the leafy heads of the trees above and the mass of vegetable mat-

* I was in the Tyrol in July 1875, when a most terrible hail storm devastated the country around Salzburg, cutting down the whole of the crops over an area of several hundred square miles. It was singular to observe how the ravages of this storm, which originated within the mountains, were confined to the plains only, no hail having fallen in the forest-covered valleys of Reicherhall and Hallein.

ter which covers the surface of the soil below in a forest, tends to prevent evaporation, and so preserves the moisture in the earth, and prevents the too sudden running-off of the water, while the roots, which do the duty of vertical drains, enable the rain to penetrate the soil to its lower beds, whence it re-appears again in the form of springs, which nourish the rivers and streams and so in turn the whole surface of the country, so that forests may be held to be great storehouses of the rain, from whence it may be drawn forth and utilised as it is wanted.

This result, when carried to excess, becomes an evil, similar to that caused by the total absence of forests. For when forests cover the whole surface of a continent, as is the case with the great marsh forests of America and Central Africa, the ground becomes so saturated with moisture that it is unable to absorb any more rain, and in consequence great stagnant marshes are formed, which either do not dry up at all, or only disappear on the return of the fine season. It is from the similarity of the results where forests are in excess, and where they are wanting altogether, that some confusion is liable to arise in treating a subject which at best is exceedingly complex and is as yet but imperfectly understood.

So far as has been shewn here, our present knowledge of the subject would seem to permit us to go, without trespassing into the limits of speculation—for only so much has been admitted as would seem to be clearly based on evident facts.

It must be allowed, however, that a number of observers, some of them of eminence in the scientific world, contest the truth, at least in a certain degree of the direct influence of forests on the climate of countries, and more especially on the rainfall. Before concluding, it will be proper, therefore, to examine the arguments which have been adduced on the opposite side.

In a work* lately published by M. Belgrand, Member of the Institute of France, and Engineer-in-Chief to the city of Paris, this subject is treated. M. Belgrand does not absolutely deny the influence of forests on the river system of a country, but he considers that they affect them only in a small degree. He divides all soils into absorbents and non-absorbents, and he thinks that inundations only occur in places where the soil is of the latter quality, and that at all events inundations depend much more on the character of the soil of a country, than on whether it is covered with forests or not. But it may be observed that a great part of the argument in favour of forests consists in the fact that they are absorbents, and that they are a natural aid to the soil in this very essential quality. Again, while M. Belgrand admits that more rain falls in the wooded districts of the Upper Seine basin than in those which are bare of trees, he asserts that he can discover no difference in the general action of the streams which have their origin respectively in both localities. He admits, however, that forests are useful in preventing the cutting-up into ravines of the sides of the valleys and hills. So again the same gentleman, while he admits that forests may exercise some influence on surface springs, denies that they can have any effect on the deep soil springs which alone never dry up. He asserts that all rain water which penetrates the earth is stopped by the first non-absorbent stratum that it meets, and that it only reappears at the surface where that stratum crops out in the general slope of the country. In fact, he considers that the deep springs which never dry up are only produced at points where faults in the formation enable the water to penetrate the non-absorbent strata. Without contesting the truth of these observations, it may be said that they do not affect the general position that has been assumed in this paper as to the action of forests; since it is clear that if forests favour the infiltration of water into the soil, they must, at the same time, assist the formation of springs, whether these be near the surface, or whether they rise in the lower strata, and, as M. Belgrand asserts, often at long distances from the forests.

M. Marie Davey, the Meteorologist charged by the French Government with the work of collating the reports on the state of the atmosphere sent in daily to Paris from all the French Departments, as well as from all the principal foreign observatories, is the type of another class of objectors. This gentleman, believing, as he does, that all movements of the atmosphere are dependent on certain great general laws, refuses to concede to forests, any influence whatever on the climate of a country, except such as is of a purely local and secondary character.

In his opinion their main use is a mechanical one in retaining the soil in its place on the slopes of valleys and mountains.

But, in conclusion, it seems to have been clearly proved that wherever countries have been denuded of trees their climate has been radically changed. Not to repeat again the case of France, Asia Minor may be quoted as a country which, in the era when it was covered with forests, was richly cultivated, and supported easily a very high rate of population, but which at the present day, owing to the destruction of the forests, has become so arid that the crops fail to come to maturity, and thousands of human beings are now perishing from hunger and want. What again would be the condition of the Upper Provinces of India, denuded as they are of trees, unless they were nourished by a very complete system of canal irrigation? As it is, years in which famine is with difficulty staved off by no means unfrequently occur. There is a curious, but very conclusive, instance which is cited by M. Cautégril, in the Cannan, a river which has its origin in the Black Mountain, in the Department Ande, in the Pyrenees, and which is used to drive a large number of cotton mills. Some years ago the Commune determined to get rid of the forests which surround the head waters of this river, but, the consequences of this proceeding having manifested themselves in the shutting-up of the mills during a considerable portion of the year, the authorities became alarmed, and the re-planting of the hills was determined on. Already, though the plantations have scarcely arrived

* La Seine, Etudes Hydrologiques, &c., par M. Belgrand, Paris.

at any considerable size, the river fills regularly as usual, and the mills are working throughout the entire year as they did before.

It is hoped that enough has been written above to shew that, while the influence of forests on the climate and physical condition of a country is undoubted, our knowledge of the subject is still exceedingly imperfect, and that the science of forest meteorology is in its infancy. Precise and systematic observations on the daily temperature, the rainfall, and on the springs and drainage, in both wooded and unwooded districts, carefully made and compared, will alone give the data requisite to arrive at a better understanding of the phenomena connected with the presence of forests in a country. It is hoped that in an age when so much is being done to promote the scientific investigation of all questions which bear on the well-being of countries and their populations, this all-important subject will receive the attention which it merits.

Mr. Fernandez communicated the following extract from the "Revue des Eaux et Forêts" in connection with the same subject.

"M. Tissandier, the well-known savant and aëronaut, in a paper read before the Paris Academy of Sciences on October 10th, 1873, gave an account of the observations he made during his recent balloon ascent. Among other things, he remarked that, when the balloon passed over a forest, the hygrometer rose with extreme rapidity, 35 degrees for instance, towards the maximum of humidity, and fell to the same point as before on leaving the wood."

Descriptive sketch of the Nasik Forest Circle, Bombay, by Mr. R. C. Wroughton.

The Nasik circle consists of the collectorate of Nasik (comprising eleven talukas) and the independent State of Peinth. It contains 6,873 square miles, and has the Great Indian Peninsula Railway running through its entire length from north to south.

The following is a statement of the population of the towns and villages of the circle:—

More than	...	200	inhabitants,	but less than	500	inhabitants	610	villages.
Ditto	...	500	„	ditto ...	1,000	„	... 624	„
Ditto	...	1,000	„	ditto ...	2,000	„	... 265	„
Ditto	...	2,000	„	ditto ...	3,000	„	... 93	„
Ditto	...	3,000	„	ditto ...	5,000	„	... 17	„
Ditto	...	5,000	„	ditto ...	10,000	„	... 15	„
Ditto	...	10,000	„	ditto ...	15,000	„	... 3	„
Ditto	...	15,000	„	ditto ...	20,000	„	... 1	village.
Ditto	...	20,000	„	... ..		„	... 1	„
								1,629	villages.

Besides these, the late census gives 607 hamlets and 69 deserted villages and 100 deserted hamlets; but, with few exceptions, the lands of these last are cultivated by the inhabitants of neighbouring villages.

The total population of the collectorate amounts to 734,386, of which 139,418 are classed as agriculturists.

The total number of houses is 133,848, which gives about 25,000 houses for the agriculturist, class, and twice this may be taken as the full number dependent for timber on the local supply. Taking as a fair average that $\frac{1}{10}$th of these require re-building every year, requiring each 5 large uprights, 20 lesser ones, and some 150 light rafters, we have a demand for at least 800,000 rafters; of these, something less than 50,000 are teak, the remainder being jungle-wood. As the price of teak is somewhere about Rs. 22 or 23 per 100 rafters, and as only 30,000 are cut in Nasik Proper, it is easy to understand how there is rarely any balance in favour of Government at the end of the year.

The distribution of the 6,873 square miles of area is as follows:—

Assessed ...	Occupied	1,806,512	acres.
	Unoccupied...	488,531	„
Unassessed	Unarable	898,045	„
or, deducting land occupied by roads, rivers, tanks, village sites, &c.,		843,113	„

The whole circle is situated on a volcanic rock (Trap), in some places cropping up at the surface, in others overlain by strata of what, in Scotland, is known as 'rotten rock,' *i. e.*, half decomposed rock, muram, or the above still further disintegrated, alluvium and humus, sometimes to the depth of 100 feet. The country is largely, if not well cultivated, and it is needless to say that the land set aside as forest is chiefly that where the rock comes to the surface, or at most is covered with a foot or two of muram.

The main geographical features of the circle are:—

The Saihadhri Ghâts, forming the western boundary of the Nasik collectorate.

The Sapt Shringh range running due east from the Ghâts.

The Aouda Patta, the Alang Kulang, and the Anjaneri ranges in the south.

The Godavery (rising at the junction of the Anjaneri range and the Ghâts) in the south, and the Girnah in the north, the Sapt Shringh range being the watershed.

From a forest point of view the circle may be divided into four well-marked tracts:

(1.) The Ghâts or Konkan. | (3.) The Desh.
(2.) The Ghât Mata. | (4.) The Deccan (Proper).

The Ghât or Konkan comprises a strip a few miles broad along the head of the Ghâts, their slopes and the low country to the west. This tract has a very heavy rainfall,—from 100 to 200 inches. The forest vegetation consists of jungle-wood trees such as,—

Sadara	*Terminalia tomentosa,*
Tiwas	*Dalbergia oojeinensis,*
Hed	*Nauclea cordifolia,*
Kanchan	*Bauhinia parviflora,*
Sair	*Bombax malabaricum,*
Kheir	*Acacia catechu* (as a timber tree),
Moho	*Bassia latifolia,*
Jambhul	*Eugenia jambolana,*
Mango	*Mangifera indica,*
Chinch	*Tamarindas indica,*

and innumerable others with a greater or less admixture of teak, growing to a fair size and naturally reproducing itself by seed. The distinctive feature of this tract, however, is the dense undergrowth of Karwand, Auli (*Phyllanthus emblica*), Apta (*Bauhinia racemosa*), the figs, the bamboo, and all the many kinds of annuals, biennials, &c.

The Ghât Mata tract is the strip of country lying immediately to the east of the Ghât tract. Its normal rainfall is from 30 to 70 inches. Here the teak never reproduces itself by seed *now*, whatever it may (indeed must) have done in times past (a riddle, of which I can find no solution). This is the region of teak coppice; there is no undergrowth but grass, and the soil during the hot weather is exposed to the full blaze of the sun. Portions of this region resemble the Konkan jungle, where the conformation of the ground gives shelter from the wind or causes an increased rainfall.

The Desh is the eastern portion of the circle to the north of the Japt Shringh range. The rainfall is from 15 to 30 inches; it is mostly a barren plain cut up by deep nalas, spotted over with isolated hills. The forest vegetation is dwarfed (with one honourable exception, the Anjan (*Hardwickia binata*), and consists of Corinda, ber (*Zyziphus Jujuba*), kheir (*Acacia catechu*), hiwar (*Acacia leucophlœa*) and many others. A peculiarity of this region is the great heat in the months of April and May.

The Deccan (Proper) rainfall is the same as that of the Desh. It is the home of the babhul (*Acacia arabica*), and grows no other tree except as an accident (fruit trees excepted). The soil is generally an alluvium more or less rich. At present the Forest Department has little or no land in this portion of the circle; but I hope that several kurans will be handed over to us when demarcation is carried.

I will now give a few details of each taluka:—

IGATPURI.

Boundaries—

S.—Alang, Kulang range.
E.—Aouda Patta range.
N.—Nasik taluka.
W.—The Ghâts.

Area.—

572 square miles.

Assessed ...	Occupied	130,846 acres.	
	Unoccupied	27,946 „	
Unarable		62,926	(57,419) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	Rs. 1,755	92	723
1873-74	„ 2,470	856	713
1874-75	„ 2,709	235	745

Establishment—

1 Inspector @ Rs. 30
1 Forester „ 8
3 Foresters „ 7

Population—57,735, of which 23,068 agricultural.

This taluka has been demarcated some 26,000 acres being set aside as reserve, saddled with certain rights. The question of the legality of these rights is too long to be gone into here, but I believe that on single right enjoyed in this circle (except that of Holkar to graze a certain number of sheep) could be substantiated in a civil court; this, however, is of little account, for these privileges must be allowed or cultivation would stop. Besides these reserves, there is one imperial reserve of about 1,000 acres at the foot of the Patta fort. It is situated in a semicircle of perpendicular rock, leaving only the mouth (a mile and a half) to be guarded. From a forest point of view, there are three well-marked divisions of this taluka. The reserves along the Aouda Patta range come under my division of the Ghât Mata forests; but the presence of this range of hills parallel to the main line of Ghâts so tends to increase the rainfall, that the lower slopes of the range, though growing little but teak coppice of any value, have still a certain admixture of inferior trees (jambhul, &c.) and worthless undergrowth. The upper

slopes, or more properly terraces, are pure evergreen jungle, mango, jambhul, &c. The reserves along the Alang Kulang range contain no teak whatever, being pure evergreen jungle. The third division comprises the main line of Ghâts and belongs to my first general division. Here teak reappears in varying proportions, and seedlings, though scarce, can always be found.

The imperial reserve mentioned above is a very promising one; at present it contains much crooked hollow wood, but this is being rapidly cleared away. A few of the Ghât jungles, too, may be improved; but the remaining teak jungles, I fear, are too far gone to recover for a very long time, all attempts at plantation having so far failed. This is largely attributable to the weakness of the protective establishment, the seedlings not having had fair play. The evergreen jungle is practically worthless. Under the most favourable circumstances mango is not a valuable wood, but here it is in a situation such that carts cannot approach within nine or ten miles of it Sowing bamboo seed is now being tried. This seems to be the only chance of ever obtaining any revenue from this kind of jungle, until roads, &c., are less rare, when perhaps, as charcoal, mango may find a market.

The establishment is—

1 Inspector @ Rs. 30
1 Forester „ 8
3 Foresters „ 7

NASIK.

Boundaries—

S.—Igatpuri taluka (Anjaneri range).
E.—Sinar taluka.
N.—Dindori taluka.
W.—The Ghâts.

Area—

375¼ square miles.

Assessed	Occupied	166,284	acres.
	Unoccupied	28,793	„
Unarable		65,900	(62,172) acres.

Population—

90,271, of which 15,724 agricultural.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	Rs. 3,415		719
1873-74	„ 3,741	3,033	607
1874-75	„ 1,938	189	787

Establishment—

1 Inspector @ Rs. 30 per mensem.
2 Foresters „ „ 8 „
2 Foresters „ „ 7 „

This taluka has been demarcated, about 25,000 acres being set aside as forest reserve. There is only one small patch of bamboo jungle of about 700 acres unsaddled with rights. By gradually buying up some eight or nine hundred acres in the immediate vicinity a very profitable reserve might be formed, bamboos having a high commercial value. The forest consists of a strip of jungle wood forest along the Anjaneri range, valuable as a fuel reserve for the town of Nasik, and another narrow strip along the Ghâts coming under my first division. There is also a patch of some few hundred acres of teak coppice jungle; but this has been so drawn upon to supply the demands of the Nasik market that it will take many years to bring it into decent order again. At present, the crooked stumps are being sold out as soon as possible for firewood, charcoal, and for wheelwrights' work. The Ghât reserves are beyond the reach of the market, and for many years will only be called on to meet the local demand. The firewood reserves are by no means in a flourishing state, there being as much, if not more land bearing nothing but grass, as under trees. These reserves will be gradually fenced up with sabri and broadcast steadily, and will soon greatly improve. There is no jungle east of Nasik. Besides Nasik, there are no large markets, though the camp and depôt at Deolali causes a steady demand for firewood.

DINDORI.

Boundaries—

S.—Nasik taluka.
E.—Niphad and Chandor talukas.
N.—Sapt Shringh range.
W.—The Ghâts.

Area—

560 square miles.

Assessed	Occupied	176,697	acres.
	Unoccupied	51,799	„
Unarable		64,686	„

Population—

68,626, of which 10,445 agricultural.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	Rs. 4,961	779	904
1873-74	„ 4,472	1,020	831
1874-75	„ 4,248	797	860

Establishment—

1 Inspector @ Rs. 30
1 Forester „ „ 10
1 Do. „ „ 8
3 Foresters „ „ 7

The demarcation of this taluka was carried out in a most desultory manner; it took four years to complete, and each year's work was done by different officers, consequently the result is patchy and anything but satisfactory, and it has been found impossible to give complete effect to the proposals even up to date. The land was merely set aside as forest reserve, nothing being settled as to what existing rights were, and even without any arrangement being made for the proper acquisition of occupied and *inam* lands included in reserve. Some 35,000 acres were placed in reserve, out of which four imperial reserves will probably be formed, one the Dehera reserve, running round the foot of the Dehera fort. The forest belongs to my Ghât Mata class, modified by the presence of the short range of hills, of which Dehera fort is the chief feature. Teak grows well from stools and even sometimes from seed, and there is a close undergrowth, most valuable as firewood for the Nasik market, from which it is only distant some nine or ten miles, and to which it is joined by a capital fair-weather road. The Umbrali reserve, of which the vegetation is of the same class as that of the above, is situated in ravines and nalas on the south bank of the Parwi river, about six or seven miles further from Nasik, on the same road (Peinth road) as the above, than which it also contains very much less undergrowth. This is a very small reserve of less than 500 acres. The Nanasi reserve, on the slope of and below the Ghâts, contains fine teak jungle, reproducing itself by seed, and mixed with evergreen trees and undergrowth. This reserve is of little importance now, there being no market for its produce, but a ghât through the centre of it, joined by a road to Dindori, or the Peinth road, has been sanctioned, and will be commenced during the present year, when this will become an important reserve, sending all its produce to the Nasik market, from which it is distant about 25 miles. And, lastly, the Ambe-Wani reserve, a pure teak coppice without any undergrowth but grass. This is unfortunately a long straggling block, running through the lands of some eight or ten villages over a series of low hills and nalas. The teak on the higher parts is very poor and thin, while in the nalas it is very fine. Both Ambe and Wani are large villages situated on the eastern boundary of the Ghât Mata region, and are consequently the natural markets for the Deccan tract. A depôt has now been formed at Ambe. This reserve promises to be of great value. The remainder of the reserves of this taluka are scattered about all over its area, west of a line drawn through Dehera, Dindori, Ambe, and Wani. East of this there are a few babhul kurans, but of small size.

Kalwan.

Boundaries—

S.—Sapt Shringh range.
E.—Baglan taluka.
N.—Khandesh.
W.—The Ghâts.

Area—

Assessed ...	Occupied	66,920	acres.
	Unoccupied	34,820	„
Unarable	... ...	79,552 (75,073)	acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73 ... ... Rs.	2,575	120	815
1873-74 ... ... „	4,303	713	723
1874-75 ... ... „	2,723	572	709

Establishment—

1 Inspector @ Rs. 30
2 Foresters „ 8
1 Forester „ 7

This taluka was formed last August twelve-month from the Abhona Petta by the addition of the Baglan taluka. I have been unable to obtain figures for the new taluka; those given above are those for the Abhona Petta. Demarcation has been carried out, but the proposals have not yet received the sanction of Government. 86,526 acres have been set aside as reserve. The whole of the forests of this taluka are, on account of the poverty of the population, saddled with rights and privileges. There is no imperial reserve nor any reserve sufficiently valuable to make it worth while to buy up existing rights. Teak coppice is scattered all over the taluka, the best being in the immediate neighbourhood of Sapt Shringh. The whole taluka is hilly, and cart carriage almost impossible. There is only one ghât into the open country by which the Kalwan teak could be brought out, and that is, a very inferior one, and until the country is opened up there can be no market for the Kalwan teak beyond the local demand for house-building. In the strip of country immediately at the head of the Ghâts, curious to

say, there is no teak. The population is composed largely of Bhils and Konkanis, both naturally poverty-stricken races. They can do no plough cultivation for want of cattle, and consequently the right to *dalhi* one acre of forest land free of assessment was granted to them by the Collector of Khandesh in 1832. The Bhils around Sapt Shringh and in the more open parts are, however, now much better off. The construction of roads and the introduction of a system of irrigation has given many means of earning a livelihood denied their more jungli brethren. It is proposed to take away from these men the privilege to *dalhi*. The poorer classes on the Ghâts, however, must *dalhi* or die, and consequently the privilege must be continued to them at least for the present.

Baglan.

Boundaries—

N.—Khandesh.
E.—Maligaum taluka.
S.—Sapt Shringh range.
W.—The Ghâts.

Area—

Assessed	Occupied	199,096 acres.
	Unoccupied	60,971 „
Unarable		140,507 (127,596) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73			
1873-74			
1874-75	359	10	110

Establishment—

1 Forester @ Rs. 10
1 „ „ 7

This taluka, like Kalwan, has been demarcated, but the proposals have not been sanctioned. It is proposed to reserve 107,940 acres. The forest of this taluka comes under the Desh class. It contains practically no teak. The chief forest tree is the Salai, *Boswellia thurifera*, for which it is to be hoped that some day some use will be found. The Salai is mixed with stunted Kheir and ber bushes and many kinds of thorny bushes for which Khandesh has always been famous. The ghât portion resembles that of Kalwan and *dalhi* is equally practised. The land reserved has been so simply with the hope of stopping the denudation of the hills which is every year becoming more apparent in the sudden flushes and floods of the Girna River. The Anjan *Hardwickia* appears in the north-east corner, but in no appreciable quantity; it remains to be seen if it will, under more favourable circumstances, spread further over this jungly, but timberless, tract.

Maligaum.

Boundaries—

N.—Khandesh.
E.—Nandgaum taluka.
S.—Chandor taluka.
W.—Baglan taluka.

Area—720 square miles.

Assessed	Occupied	186,474 acres
	Unoccupied	155,259 „
Unarable		119,970 (106,662) acres.

Financial Statement—

	A. Expenditure.	B. Expenditure.
1872-73		103
1873-74	15	103
1874-75		51

Establishment—Nil.

This taluka has not yet been demarcated. It contains no teak whatever, its only timber tree being Anjan. In a commencement of demarcation made last year one imperial reserve of some 15,000 acres was marked out at Galna on the Khandesh boundary. Here the Anjan grows freely from seed; ⅔rds of the proposed reserve bears Anjan naturally grown from seed. Anjan leaves unfortunately are splendid fodder for cattle, and when grass is scarce, *i. e.*, for three months of the year, the Bhil herdsman hacks down half an acre of Anjan seedlings in order that his cattle may graze more at their ease. The result is acres on acres of the most miserable-looking, gnarled and twisted pollards that can be conceived. The remainder of the taluka (for the Anjan only grows here) is the typical Desh jungle thorn-bushes, nalas, shoot-rock, and boulders. Maligaum used, in former days, to be an important military station, but has now dwindled away. The native town is still, however, one of the largest in the district.

Nandgaum.

Boundaries—
N.—Khandesh.
E.—The Nizam's Territory.
S.—Yeola taluka.
W.—Maligaum taluka.

Area—404 square miles.

Assessed ...	Occupied	80,745	acres.
	Unoccupied	86,666	,,
Unarable		79,716	(75,260) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	305	...	120
1873-74	246	150	117
1874-75	186	352	125

Establishment—
1 Forester @ Rs. 10.

This taluka has not been demarcated, but at least 100,000 acres should be set aside as fuel reserve for the railway. There is no timber tree in the taluka except a little Anjan in the north. Besides the railway, there is no market for the produce of this taluka except a fitful demand at Yeola.

Yeola.

Boundaries—
N.—Nandgaum taluka.
E.—Nagar.
S.—Niphad taluka.
W.—Chandor taluka.

Area—419 square miles.

Assessed ..	Occupied	134,011	acres.
	Unoccupied	15,891	,,
Unarable		36,117	(35,654) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	72	...	...
1873-74	46	155	...
1874-75	45	...	...

Establishment—Nil.

This taluka is a purely Deccan one (every inch of cultivable land is occupied and passed on from father to son, the assessment being paid whether the land be cultivated or no). It has not been demarcated, but there is nothing to take but a few kurans. Yeola is one of the largest towns of the district, and there is the ordinary demand for firewood for household purposes, but nothing more.

Chandor.

Boundaries—
N.—Sapt Shringh range.
E.—Yeola taluka.
S. & W.—Niphad and Dindori talukas.

Area—282½ square miles.

Assessed ..	Occupied	129,806	acres.
	Unoccupied	8,059	,,
Unarable ...		50,561	(48,248) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	...	...	..
1873-74	942	89	...
1874-75	153	...	...

Establishment—Nil.

This taluka is undemarcated. The northern jungles on the slopes of the Dhorab, Raj, Indrac, Chandor and other forts of the Sapt Shringh range belong to the Ghât Mata class, while the rest of the taluka belongs to the Deccan division. The teak jungle is very poor indeed, though the great demand for teak makes it valuable. There is no market at present for firewood.

Niphad.

Boundaries—
N.—Yeola taluka.
W.—Nagar.
S.—Sinar taluka.
E.—Dindori and Chandor talukas.

Area—330½ square miles.

Assessed ...	Occupied	153,945	acres.
	Unoccupied	915	,,
Unarable...		29,163	(28,671) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73	Rs. 2	...	
1873-74	„ 551	586	.
1874-75	„ 46	..	...

Establishment—Nil.

This taluka is undemarcated; it belongs to the Deccan class. There are a few kurans to be taken up, the produce of which will find a market on the railway which traverses the taluka.

SINAR.

Boundaries—

N.—Niphad taluka.
E.—Nasik taluka.
W. & S.—Nagar.

Area—506 square miles.

Assessed	Occupied	199,546 acres.
	Unoccupied	5,412 „
Unarable	... ...	96,870 (96,327) acres.

Finanical Statement—

	Receipts.	A. Expenditure.	B. Expenditure
1872-73 . . ..s .	Rs. 663	.	120
1873-74	„ 507	137	123
1874-75	„ 637	300	120

Establishment—

1 Forester at Rs. 10.

Demarcation proposals have been submitted for this taluka, but not yet sanctioned. The 100,000 acres of unoccupied land is situated on the range of hills dividing it from Nagar in the south. There is no vegetation whatever; even grass only grows in small patches. The whole range is one sheet of rock. Acres of forest of the Ghât Mata class, containing a little teak and a great deal of tiwas and kheir, have been set aside as a fuel reserve for the Deolali Camp.

PEINTH STATE.

Boundaries—

N.—The Sulgana State.
E.—The Ghâts.
S.—Thana.
W.—The Dharampur State.

Area—960 square miles.

Assessed	Occupied	182,077 acres.
	Unoccupied	12,021 „
Unarable		72,077 (65,330) acres.

Financial Statement—

	Receipts.	A. Expenditure.	B. Expenditure.
1872-73 . .	Rs. 8,181	1,463	1,553
1873-74	„ 22,224	2,044	1,561
1874-75	„ 22,658	1,359	1,488

Establishment—

2	Inspectors @	Rs. 30
1	Karkun	„ 15
2	Foresters	„ 10
2	„	„ 8
2	„	„ 7

The Peinth State has not been demarcated, and the work when undertaken will be found a most difficult one. The fields are bordered with undergrowth, which, from the top of the Ghâts, gives the country the appearance of one vast forest. The census gives a population of 47,033, of which only 7,601 are agricultural. According to this every man must cultivate from 250 to 300 acres (even supposing the whole agricultural population to be men only), which is absurd. I believe the Kolis, Konkanis, and other wild tribes have not been included—Dalhi rab, with a large proportion of capital-less cultivators, must, of course, be the rule. The forest might contain splendid timber indeed; Peinth teak was long well known. Now, reckless cutting by greedy contractors, clearing of the undergrowth for rab for increased cultivation have very nearly ruined the forests. The State, however, has one great stand by. *viz.*, its bamboos. The whole Deccan is supplied by Peinth. But even this supply must soon fail, unless measures of conservation be taken. The revenue system in Peinth is that known as authandi, consequently no numbers are marked off, and I have seen acres of bamboos, the thickness of one's thumb, cut down and burnt where they lay, thus destroying immature produce and producer, the ground to be probably thrown up a few years later and covered immediately by a dense undergrowth of useless vegetation to the exclusion of better kinds. The whole State is an intricate net-work of hill ranges and deep ravines. In the last few years it has been a good deal opened up; but it must be very much more so, and above all a good road made to the coast before the true value of its forests can be realized. Teak and bamboos, and a little sissu, is the only material which it pays to export to Nasik, though the coast is the chief market, especially now that the Dharampur State has been gutted and obliged to cease cutting for a series of years.

On the expediency of enlisting Village Officers for the protection of Forests, by NARAYEN ANANT OKEDWAY, *Bombay Forest Department.*

Without touching upon the influences of forests or mentioning the benefits which a country derives from their growth, both of which are well known, I proceed to the subject in hand.

2. The subject of enlisting village officers for the protection of forests in the Bombay Presidency, where forests are interlaced with cultivation, is so important that it would be detrimental to the interests of both Government and the public if measures be not soon adopted to gain such important aid. My experience leads me to believe that, for the proper protection and management of forest property which, as observed above, is interlaced with occupied lands, it is most essential to secure the good-will and co-operation of the inhabitants of forest villages. Paid servants of Government will not be able to preserve the State forests without their assistance, however efficient by qualification and large in number they may be.

I am of opinion that the village officers, from the position they hold in the village community, are best suited for the work of preserving forests. This work should be entrusted to them and the superintendence vested in the paid servants of the Forest Department.

3. There is another reason for calling for assistance from village officers for the protection of forests. At present a forest officer, may he be a District Forest Officer or Conservator, not being vested with the powers of a police officer, cannot legally arrest a person removing wood from the forest. He must catch him in the act of cutting with an axe in hand, and there must be at least two witnesses besides to prove his guilt; nor can he, without a warrant from a Magistrate, search any house, however strong the suspicion or reliable the information he may have received as to the house containing stolen wood from Government forests. Owing to this, convictions are scarcely ever obtained, and perpetrators of forest thefts remain unpunished.

When forest offenders are thus left unpunished, conservancy is at an end; but if the good will and co-operation of village officers be secured, then much good may be effected. The same view was, I believe, entertained by Dr. Gibson, as is shewn by the *kabulayats* (agreements) taken by him in several collectorates, which were generally drawn up in the names of the then village officials, and where they declined, in the names of other individuals, but the principle on which he proceeded being faulty in some respects, as will be shewn hereafter, the above agreements did not produce the expected result.

4. Before pointing out the defects in Dr. Gibson's system and making proposals for the future organization of forest village officers, it is necessary for me to say a few words in explanation of the character of the tenures of several officers appertaining to a village. The patel, the kulkarni, and the mahar are considered, at present, the only hereditary officers of a village. The following are the duties which they perform: The patel, who is the headman of the village, is required to collect the revenue for Government, send the same to the taluka treasury and report to the mamledar whatever happens in the village worth taking official notice of. In matters relating to the police he makes his reports to the chief constable. The kulkarni writes the *dufter* (records) and keeps the accounts of the village; although he is paid more than the patel, still he is subordinate to the patel as a Government servant, and, in fact, is the patel's clerk. The mahar has to watch over the boundaries of the village and guard the crops whether cut or growing as long as they are in the field. He is required to carry the revenue of the village to the taluka treasury, and is also the official village messenger. Of the above officers the first two have each hereditary *watan*, that is to say, each of them receives a certain fixed amount in cash from Government for the services he renders, and in some cases enjoys a piece of land as inam; while the third officer, namely, the mahar, does not get anything in cash, but has only in inam a piece of land called *hadola*. There being many sharers in these watans, no one of the men is a permanent officer, but each comes into office according to his turn and serves for a period of five years. Some of the sharers hold so small a share in their watan that they hardly get an opportunity to come into office during the whole of their lives. It is no wonder that those in office have much influence with the villagers and are much feared by them, while the ex-officers or other co-sharers carry with them no influence whatever. Of the village officers the patel and kulkarni receive their wages for a period of five years on the average revenue of the past five years according to the following scale:—

	Patel.	Kulkarni.
On the 1st 1,000 rupees	3 per cent.	5 per cent.
„ 2nd „	2 ditto	4 ditto
„ 3rd „	1 ditto	3 ditto
„ 4th „	1 ditto	2 ditto
On a sum exceeding Rs. 4,000	1 ditto	1 ditto

5. I observe that these village officers shew a total disregard for the preservation of forests, while they exhibit interest in the discharge of their revenue duties. This disregard, I believe, is owing to their utter ignorance of the advantages derived from arboriculture, as well as to the loss they are made to suffer on account of land retained for forest, because under the

present system the assessment on these lands is not included in the revenue of the village on which their remunerations are calculated To these remarks there are some exceptions. There are really some officers who, through the fear of being punished by the Collector, render efficient service to the forest department. These remarks are made in reference to the officers of those villages in which lands were long ago taken up for forest, but it must be borne in mind that the officers of the villages in which fresh lands will be reserved are likely to show more disregard and inattention to forest business, as people are becoming, day by day, more alive to their own immediate interests.

It is, therefore, necessary to devise some measures by which the village officers may not be put to any loss and the forest department may have every means at their command to increase the growth of forest on which the fall of rain to some extent depends, and the wholesale destruction of which has entailed barrenness and aridity on countries formerly renowned for their fertility, and caused the disappearance of springs and rivulets, as well as a very sensible increase of heat in the temperature

6. Dr. Gibson, as before stated, took agreements only from parties then officiating, no consideration being shown to the fact that they were then acting only for a time, consequently, when they fell out of office, they were not in a position to protect the property entrusted to their care, while those who succeeded them naturally thought that the agreements were binding only on the parties who had made them, and that they would receive nothing in return for their services. These men, therefore, had no interest in the preservation of forests, the consequence of which is their destruction,—hills which nature intended to be forest-clad have been stripped of trees Had the parties entering into agreements been told that these documents would be considered to create a new hereditary watan, the agreements would shew it, and they (the parties) would have been of some use now to this department The heirs and representatives of the original parties would have naturally come forward on their demise, and would have had their names entered in their stead Under the present circumstances it must be presumed that no such intimation was given when agreements were taken up

7 By the above agreements the share therein stipulated becomes payable only when forest revenue is realized This has, in my opinion, principally marred their utility, because as forest revenue is collected at long intervals it becomes next to impossible to punish them for their negligence and fraud To meet this difficulty Dr Brandis, Inspector General of Forests, proposes* that a fixed sum according to the yield of a forest should be settled and paid annually to a rakhwaldar, which should be decreased in case of negligence and increased for efficient service, but from what class of men the rakhwaldar is to be selected is not stated Taking for granted that he is to be one of the three village officers, still without the co-operation of the other two, he is of no use to the department, as in the case of a divided watan he is not likely to be serviceable except during the term of his office, the reasons of which have been already explained, and, therefore, need not be repeated here.

* *Vide* paragraph 5 of his report No 209, dated 18th June 1870, published with Bombay Government Resolution No 3756 of 6th August 1870

8 I have personally heard several village officers openly state that they are in no way responsible for the condition of the forests, as they are not paid for guarding them. High officials of Government also remark to the same effect They consider that as Government have opened a separate department altogether for the management of forests, it is their business to protect them. Whether what they say is just and reasonable or otherwise is a question which I am unable to discuss, but if it be reasonable, some measures must soon be adopted to make the village officers responsible, for there is no other mode of preserving forest property safer and less expensive than the enlistment of the sympathies of these officers by conferring on each of them in the form of a watan a certain annuity which need not exceed the amount due on the assessment of the land occupied by forests, according to the scale under which they are paid in the Revenue Department It has been already mentioned that the two village officers, the patel and kulkarni, receive their respective remunerations for a term of five years, calculated, as shown above in paragraph 4, on the average income of the village for the preceding five years, but the case of the third village officer, namely the mahar, is different, he does not receive anything of the kind, nevertheless, the services he renders to the village community as well as to the State, are by no means less important, and in my opinion his assistance is indispensably necessary for the proper preservation of Government forest, and therefore, he necessarily deserves some remuneration if he be called to render that assistance.

9. I beg, therefore, to propose that the above officers, patel, kulkarni, and mahar, of a village be appointed to look after its forest, and the first two be remunerated on the assessment of the land under forest at the rates they are allowed in the Revenue Department, while the third be paid either a fixed sum or at the same rate as the patel, that these proposals be made applicable to the lands already under forests as well as to those that will hereafter be taken up by this department. It will, no doubt, be impracticable to carry them out in the case of forest lands not assessed, where such difficulties exist it would be necessary to get such lands assessed under the existing rules. Land under cultivation is generally re-surveyed and re-assessed on the expiration of 30 years, the same rule should be observed in the case of land under forest. Such an agreement will hardly leave any ground to village officers for grumbling. If the proposals herein made be acted upon, the assessment on the forest land in each village will have to be added to the gross revenue of the village and the percentage remunerations calculated thereon; the forest department will have to provide for the increased percentage which will thus be paid.

10 The elections of patel and kulkarni take place every five years, when they are required to give in kabulayats for the due discharge of their duties. I do not think it necessary that

they should be called upon to give separate kabulayats for the correct performance of their forest duties; it would be sufficient if a clause regarding it be inserted in their kabulayats in the revenue department. Entrusting solely the custody of Government forests to the care of these officers would not conduce to good results if no supervision or control be exercised over them. The Conservator must have authority to fine them the whole or a part of the wages they receive in case they be found guilty of negligence or fraud. When an offence warrants either a heavy fine or dismissal, he should report the same to Government. At present no kabulayat is demanded from the third village officer (the mahar) in the revenue department, and I do not see the use of this department getting one from him if the power of punishing him for negligence, &c., be vested in the Conservator.

11. Should the above suggestions be carried out, they would, undoubtedly, contribute a great deal to the protection of Government forests with less expense and trouble. As the remunerations which the village officers would receive would form watans, they would, no doubt, discharge the duties appertaining to them diligently and satisfactorily. It is a well-known fact that the natives of India are very fond of watans, and ready to sacrifice all that they have to get the upper hand in a matter relating to them, however trivial it may be. I, therefore, do not think that they would act in a way to forfeit this newly-acquired watan.

12. A paper similar to this, but having a special reference to the Dekkan Collectorates only, was originally written for the last Allahabad Forest Conference, but it was not forwarded there as the subject did not appear in its programme. This paper was circulated for perusal and remarks to several experienced officers, both European and Native, who have favoured me with their opinions. Two of these officers, Messrs. A. H. Spry and W. Allen, have stated that there are a great many objections against the creation of forest watans, and in the face of these they do not think that Government would ever sanction them.

"If forest watans," Mr. W. Allen observes:—

"Are to be created, either an Act defining the powers of Government and the rights of the watandars as regards appointments, dismissals, duties, and emoluments, will have to be enacted, or else the kabulayats will be in reality a mere contract between Government and the appointee, and each such kabulayat would have to contain in detail all the provisions which an Act on the subject would contain; and Government would be at this disadvantage, that they would have bestowed an hereditary right which it would appear invidious subsequently to cancel after a few years by legislation, if the system did not work well or was no longer required, or if the Civil Courts in case of dispute happened to take a different view of the interpretation of the Kabulayat to that which was intended by Government at the time it was drawn up."

In order that there may not be any misunderstanding in the matter, I think it necessary to say that, by the creation of forest watans, Government do not lose anything, because, prior to the organization of the forest department, the assessment on, or gross receipts of, the lands now under forest were included in the gross revenue of the village, and the remunerations to the patel and kulkarni calculated thereon; but now the case is different: village officers are put to loss, as the gross revenue of the village on which their remunerations are calculated, does not include the assessment on, or gross receipts of, the lands transferred to the forest department. With a view to compensate them for this loss, (exacting from them at the same time great responsibilities) the above proposals are made. If there be any objections in the way of giving them a fair trial, then, as a secondary measure, I would plead for a system of money payments to patels, kulkarnis, and mahars of forest villages. These payments would, of course, be according to the yield of the reserves in each village, and would not be paid till the expiration of each year, and then, should the village officers be found to have been remiss in their work, deductions could forthwith be made in proportion to the remissness proved. A great deal of emulation and incentive to exertion might also be excited by an occasional but judicious distribution of turbans, over and above their annual wages, to each of them who had shown any remarkable interest in looking after forests during their incumbency.

13. I have always felt that the work of conserving Government forests must be done through the village officers, and their charge may be safely left to them. Particularly if either of the schemes of remunerating them, as proposed above, be introduced, I am confident they will be only too willing to assist this department in the work of conservation.

14. Several persons having interests in forest matters suggest the investment of the chief executive officers of the department with magisterial powers in order to protect the interests of Government in forests in a better way than at present. I also think that the above suggestion would be productive of good results, but I would not on that account recommend its adoption under the present circumstances. The forest department is already unpopular, and it would be more so if its executive officers be allowed to dispose of criminal cases in which they themselves or their subordinates are likely to be complainants, and difficulties with respect to obtaining labour for its several operations, as well as with respect to the protection of Government forests, would gradually increase. If people are thus once arrayed against the department its progress will be greatly obstructed. I am of opinion that the plan of appointing village officers as forest guards is more suited to the present circumstances than investing the executive officers with magisterial powers.

APPENDIX II.

Extract Report on the Forests in Rajputana, by D. BRANDIS, *Inspector General of Forests, January* 1871.

IN obedience to the orders of the Government of India, I marched through a portion of Rajputana in December 1869 and January 1870 on my way to the forests of the Bombay Presidency, and after carefully considering the results of my enquiries on that tour, beg now to submit the following report on the subject.

2. In Bhurtpur I visited a number of the wood and grass preserves belonging to the Raj. In Jeypur I examined the vegetation of the hills north of the town; made an enquiry into the cause of the shifting sands near the city, and submitted to the Agent to the Governor-General for Rajputana a report with suggestions for improving the present state of things.

3. From Jeypur I proceeded to the Sambhur Lake; thence passing through the northern portion of the Kishengurh State, I entered the British Province of Ajmere near its northern extremity. From here I passed a short distance through the Marwar territory, and thence proceeded to Pohkur. From Pohkur I ascended the Nag Pahar range; examined the so-called preserve on the top of it, and arrived at Ajmere on the 23rd. After examining the hills in the vicinity of Ajmere, I went on to Nusseerabad, and thence to Beawur and Todghur, in Mhairwarra.

4. From Todghur I proceeded to Bednore, the seat of one of the principal Meywar Thakurs, and after examining the hill jungles on his property, crossed to Humeergurh on the Bunass river, the seat of another nobleman, where I saw some excellent pieces of coppice, mainly consisting of a species of *Conocarpus** with small leaves. I then went eastward to the hills beyond the Betuchee river, a tributary of the Bunass, where I examined the large forest reserves of the Thakur of Bassi; thence to Chittore and Neemuch. From the latter place I went westward to the extensive jungles about Chota and Bara Sadri—two places which take their name from the Sadra or Hadra tree (*Terminalia tomentosa*) which, though near its northern limit in these parts, is abundant in the vicinity. Thence I marched across to Pertabgurh, and after passing through the Pertabgurh and Banswarra States, and the territory of the Thakur of Kishengurh, reached the Panch Mehals of the Bombay Presidency, encamping at Jhallode on 22nd January.

5. During this tour I thus became acquainted with a considerable portion of the British districts of Ajmere and Mhairwarra, and of the country along my line of march through the States of Bhurtpur, Jeypur, Kishengurh, Meywar, Pertabgurh and Banswarra. I passed through the territory of Marwar for only a short distance, and saw nothing of the other States of Rajputana.

6. Throughout the greater part of the Native territory visited by me, I found regular preserves set apart for the protection of game and the production of grass and wood. The botanical character of the trees and bushes in these preserves varies with the soil and other physical features of the locality, and with the situation of the district. Thus the large Chunna near Bhurtpur, which occupies about 40 square miles, is mainly stocked with *Prosopis spicigera* in places with stiff and poor soil, with *Salvadora* on saline ground, and with *Babul* on the patches of lighter soil intervening; while on the lower and moister grounds there are fine groves of *Neem, Nauclea parvifolia, Ulmus integrifolia*, and other kinds. The dry hills round Jeypur are mainly clothed with trees of the small-leaved *Conocarpus* adverted to above.

7. The game preserves of Kishengurh consist mainly of *Prosopis, Capparis aphylla* (Kaer), *Boswellia thurifera* (Salér), *Moringa concanensis* (Seinjna), the *Conocarpus* before mentioned, and a species of *Cordia*, with clumps of a fleshy *Euphorbia* (E. *columnaris*) on the more stony parts.

8. On the hills near Bednore there are a variety of shrubs, of which it may be sufficient to mention the small-leaved *Conocarpus, Acacia Catechu, Boswellia, Moringa concanensis* and *Ægle Marmelos*. In Humeergurh, and to the south of the river Bunass, the country is characterised by scattered forests, composed principally of the small-leaved *Conocarpus*. This tree generally covers the low hill ranges; it is more or less associated with a variety of other trees and shrubs, of which the chief are *Acacia Catechu, Zizyphus vulgaris* and *xylopyra, Bauhinia, Boswellia* and *Prosopis*.

9. South-east of the Betuchee Nala, the vegetation becomes more varied. The hills in the territory of the Bassi Thakur are covered with a luxuriant forest from 20 to 30 feet high, in which *Acacia Catechu, Conocarpus latifolia*, in addition to the small-leaved species, *Dalbergia latifolia, Ægle Marmelos, Acacia Sirissa, Emblica, Terminalia bellerica, Sterculia, Bauhinia* and *Dipterix* are some of the principal trees, mixed with good bamboo (*Bambusa stricta*). The base of the hill on which the old fort of Chittore stands is clad with a fine, dense forest of *Conocarpus*, and the sacred forest groves which abound in these parts of Meywar consist chiefly of the same tree.

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* This *Conocarpus* (now called *Anogeissus pendula*) which I have found in Meywar on the Jeypur hills, and on the Pachmurrees south of the Nerbudda river, has been called *Conocarpus acuminata*, but it is a different species from that found in Burma and Southern India, which is generally known under the name of *C. acuminata*.

10. To the south-west of Neemuch near Sadree, and in the States of Pertabgurh and Banswarra, the vegetation assumes a tropical character. Teak begins to appear in these districts, and *Terminalia tomentosa* and *Pterocarpus Marsupium* are the chief trees of the forest. Bamboos of considerable luxuriance are produced in profusion, forest land being here more plentiful, and cultivation more scattered as a rule; the only preserved spots are the sacred groves here called Malwans, and they are most rigidly looked after by the Bheel Chiefs. Here and there, however, I came upon hills covered with well-grown teak, not in any way regarded as sacred, which I was told the people abstained from cutting until the timber should grow larger and have a better marketable value, and also as a resource to fall back upon in case of famine or other misfortune. The Chiefs of Kishengurh (tributary to Banswarra) have, for a considerable time past, preserved a valuable teak forest on the road from Kishengurh to Rutlam, which I examined with great satisfaction on the 21st January.

11. The result of my enquiries has been that, in the States of Bhurtpur, Jeypur, Meywar, Kishengarh, Pertabgarh and Banswarra, as well as in the estates of the subordinate Thakurs and other noblemen in these territories, the custom prevails to preserve certain tracts of forest and grass lands to furnish cover for game, and as sources of a permanent supply of grass, wood and timber, or in the case of the sacred groves, for religious purposes.

12. The sacred forests are, as a rule, never touched by the axe, except when wood is wanted for the repair of religious buildings, or in special cases for other purposes. The other preserves are generally open under certain restrictions for the use of the surrounding population.

13. These restrictions vary in different localities, and in the same manner, there is great variety in the degree of protection afforded to these forests, and in the means employed to secure this protection. Thus, in the Bhurtpur Ghunna, any one may cut dry wood, and a certain class of poor people make a regular livelihood by collecting and selling firewood in the town of Bhurtpur. Here they have adopted a regular system of breaking the branches of the trees in order that they may become available as dry wood, to the great injury of the forest. This Ghunna is in charge of a Foujdar, who has a guard of 100 sepoys to watch it. Two hundred maunds of fire-wood are daily brought in for the consumption of the different departments and workshops of the Raj, besides timber of Babool and Neem, as may be required. The Ghunnas in the districts of this State are generally in charge of the respective tahsildars, and are principally used to furnish the needful grass for the Raj cattle, horses and elephants. The following is a list of the preserves in the Bhurtpur State, as communicated to me by Bunsee Shur,—the Vakeel in attendance upon the Political Agent of Bhurtpur:—

1.—Bhurtpur Ghunna, area about 40 square miles.

2.—Huilah (Pergunnah Bhurtpur), about 16 square miles.

3.—Gurrhee and Paharṭal (Pergunnah Deeg), about 5 square miles.

4.—Khoh (Pergunnah Deeg), about 5 square miles.

5.—Roopbass, about 16 square miles.

In some Ghunnas cattle are permitted to graze under certain restrictions.

14. The preserves in the Kishengurh State were of extreme value to the people during the recent famine. The Rajah gave special permission to lop the branches of the *Prosopis spicigera* and other trees for their cattle, by which means many were preserved from starvation.

On the hills south-east of the Betuchee Nala, the shifting cultivation by cutting and burning the jungle, locally called Balree or Valree, is permitted to members of certain Bheel tribes; but the forest is there extensive and comparatively dense, and re-produces rapidly.

15. As regards the working of these preserves, I did not, as a matter of course, expect to find any regular system of cutting and re-production. As a rule, wood or timber is cut promiscuously where it happens to be most convenient; and in one locality only, in the coppice woods of the Raogyee of Humeergurh on the Bunass river, did I notice a pleasing exception. They are principally composed of the small-leaved species of *Conocarpus* already adverted to, which coppices freely; and here I saw a regular gradation of coppice from that just cut, through the various stages of growth, to wood fit for cutting.

16. In the British districts of Ajmere and Mhairwarra, the Government gave up at the settlement all rights of occupancy in the waste as well as in the cultivated lands. The waste lands of each village are entered as "Shamlat," or common property. The revenue derived from them is considered to belong to the proprietors paying the Government demand; the village expenses are defrayed from this income, and the surplus is distributed to the Khewatdars. Finally, these Shamlat lands may be divided at the pleasure of the people in proportion to their shares, either by themselves, or through an Ameen. These were the arrangements made at the settlement in 1852 (see pages 86 and 179 of the settlement report of Ajmere and Mhairwarra, Agra, 1853). It seems doubtful whether, under these arrangements, these lands have not more the character of private than of public property. So much however, is certain, that Government has reserved to itself very limited rights, if any, in these lands.

17. The practical result of this policy, which was doubtless dictated by the highest motives, has not been satisfactory. While in some of the neighbouring Native States, where the Chiefs have wisely reserved their rights to the uncultivated lands, there are extensive and useful wood and grass reserves, the waste lands of Ajmere and Mhairwarra are for the most part utterly barren, producing little besides *Euphorbia*, and a few scanty shrubs of wild indigo.

18. Under these circumstances, I see no chance of realising any forest revenue Ajmere and Mhairwarra sufficient to maintain a forest officer for these districts. Doubtless it would be most desirable to do something for the preservation and improvement of the scrub-jungle still existing on these nominally communal lands In some places a richer vegetation would prevent the spread of the shifting sands, and in others, it would aid to husband and to regulate the water-supply of the tanks which must always form the main source of prosperity to the agricultural population of these districts.

19 This appears to me to be particularly important in the district of Mhairwarra Here I noticed in most cases that the hills in the vicinity of the tanks are more completely denuded of every kind of vegetation than those further distant This is natural, as the villages are generally located near tanks, and their cattle graze over the nearest hills, and wood and grass for domestic use are ordinarily cut in the nearest jungles. I examined several out-of-the-way and thinly-populated jungles in Mhairwarra, and found hills and valleys covered with what, considering the dryness of the climate, must be called a surprisingly luxuriant forest vegetation, frequently reaching a height of from 20 to 30 feet, with a good proportion of *Acacia Catechu* and other valuable kinds

20 The hills of Mhairwarra are capable of supporting a fair amount of forest vegetation, but in most places it has been checked or destroyed by the constant demands made upon it, and by the absence of all protection. Besides the wants of the agricultural population, the requirements of the Cantonment of Nusseerabad have been a heavy drain upon the resources of this district Thus the eastern face of the hills stretching from Todgurh to Bednore, as far as they are in British territory, presents a perfectly desert aspect, having been denuded of every stick of hard wood, principally *Acacia Catechu*, by the charcoal-burners of Nusseerabad. Here and there an isolated tree of *Boswellia* remains to shew the height which the original forest attained As soon, however, as I entered the adjacent territory of the Thakur of Bednore, I found the country fairly well-wooded, not a tree having been felled On enquiry I learned that the Thakur had prohibited the cutting of any wood by outsiders, in order, as one of his family explained to me, that a plentiful water-supply might be ensured to the tanks on his property.

21 It has been said, with reference to these districts, that the demarcation and protection of selected portions of waste lands to be gradually converted into productive coppice or forest, would be a measure of great importance which would be beneficial to the country, and by way of example, might be expected to do good in the surrounding Native States.

22. We will hope that eventually some means may be devised to make available the needful waste lands for carrying out this plan But, under existing circumstances, the Native Chiefs of Rajputana have certainly nothing to learn by way of example from the manner in which the waste lands of Ajmere and Mhairwarra have hitherto been treated It will be a matter for the most serious consideration of the revenue authorities, how far Government is bound in perpetuity by the arrangements made at the settlement in regard to the waste lands in these districts. If it were possible to vindicate their character as public property, the State, as the guardian of all public interests, might assume their management, retaining a sufficient share of the revenue to defray the expenses of management and supervision. The waste lands would still remain the property of the villages, but they would be managed by Government on their behalf.

23 In Mhairwarra especially, I would urge the consideration of some such measure for all hills whose drainage fills the tanks The scanty rain-fall on those hills does not come down continuously throughout the year, but in a small number of heavy showers, which, not being retained by any vegetable cover, rush down the barren hill-sides in torrents, silting up the tanks and breaking bunds, instead of filling the tanks gradually and steadily. It is evident that, if by any means these hills could be covered with trees and brushwood, the surface drainage would be regulated, and the water-supply to the tanks would be improved These are the questions which should, in my opinion, be carefully considered by the revenue authorities

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